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Approach and Policy in Higher Education for Sustainability

Edited by
Gazi Mahabubul Alam

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Editor

Gazi Mahabubul Alam

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Editor
Gazi Mahabubul Alam
Faculty of Educational Studies
Universiti Putra Malaysia
Serdang
Malaysia

Editorial Office
MDPI
St. Alban-Anlage 66
4052 Basel, Switzerland

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About the Editor

Gazi Mahabubul Alam

Professor Gazi Mahabubul Alam, PhD, FRSA is an internationally recognised Public Policy Analyst with a special focus on higher education and skills development. Countries of his work experience include Malaysia, Bangladesh, the UK, Canada, China, and the USA. He works for both the Institute of Higher Education and Partner for Development.

Before joining the Faculty of Educational Studies, University Putra Malaysia (UPM), he was a Professor in the Department of Economics, East West University (EWU). Alam also served as a Professor of Public Policy and Chief Consultant at the Academic Performance Enhancement Unit, University of Malaya (UM), Malaysia. In 2010, Alam received full professorship from the UM. Prior to joining the UM, he worked as a Policy Specialist (skills) at the International Labour Organisation (ILO). He is also currently involved with Chengdu University, Sichuan, China.

Alam acquired an MA in International Education and Development from the University of Sussex and a PhD from the University of Nottingham. He received a distinguished fellowship from the Royal Society of Arts.

He has published a number of papers, and they have received a notable amount of citations. His recent contributions are included in some high-ranked journals such as *Higher Education*, Springer; C*omparative Education Review* (CER), University of Chicago; *International Journal of Sustainability in Higher Education*, Emerald; *Education 3-13*, Taylor and Francis; *Higher Education, Skills and Work-Based Learning*, Emerald; *Technological Forecasting and Social Change*, Elsevier; *Technology in Society*, Elsevier; *Education and Urban Society*, Sage; *International Journal of Educational Reforms*, Sage; *Journal of Business Research*, Elsevier; *International Journal of Comparative Education and Development*, Emerald; and *Business Process Management Journal*, Emerald.

Preface

In the era of the SDGs (Sustainable Development Goals), the terms sustainability and sustainable development are overly used and often misinterpreted. The terms sustainable education, education for sustainable development, and sustainability in education are connected as a conjunction rarely; they also indeed hold distinction. Such distinction may not isolate them from each other, but it would help them to have a subjective identity and connotation. For instance, the study of sustainable education refers to any form of investigation that ensures high-quality and relevant education and learning in the contemporary world by contributing to a change to either the system, to the course and curricula, or to infrastructure and delivery.

The study of education for sustainable development includes investigations that support the education system in playing a pivotal role in achieving at least one of the SGDs (Sustainable Development Goals). Sustainability in education has become a common term and is often misused. Subjects such as environmental science, geography, and archaeology have a long history and heritage. Despite the vibrant existence of these subjects, we are facing a sustainability crisis on Earth. Without digging up the underpinning reasons causing such a sustainability crisis, various subjects are blamed, arguing that they are too backdated to tackle the sustainability crisis in the era of modernisation and commodification. Hence, to ensure a collective effort, an assembly of these subjects is suggested, a metaphor that popularises the new phenomena, which is branded as sustainability in education.

Higher education is seen as the hub of knowledge creation that can construct the economy—an orthodox tenet—waiting to be falsified. In the era of commodification, a new melody would ideally be composed, suggesting that funds are at the heart of research, thereby economy is the backbone of knowledge. Hence, knowledge is the puppet that the fund deserves. Acknowledging this climate, the philosophy of this Special Issue was developed.

The purpose of this Special Issue is to cover three areas, namely sustainable education, education for sustainable development, and sustainability in education, to understand the distinction amongst them. We also aimed to see if a connecting point could be found where these topics are part of a nuptial to play a sustainable role for the development of education and society, as well as beyond.

Gazi Mahabubul Alam
Editor

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Editorial

Sustainable Education and Sustainability in Education: The Reality in the Era of Internationalisation and Commodification in Education—Is Higher Education Different?

Gazi Mahabubul Alam [1,2]

[1] College of Overseas Education, Chengdu University, Chengdu 610106, China; gazi.mahabubul@upm.edu.my
[2] Department of Foundation of Education, Faculty of Educational Studies, University Putra Malaysia, Serdang 43300, Malaysia

1. Introduction

Sustainable education refers to knowledge delivery that ensures a balanced national development which encompasses both economic and social development as well as a human needs perspective [1]. In the era of globalisation, international education, particularly education in the West, dominates the globe, which subsequently contributes to international development by developing a "dependency theory" for the East to follow [2]. Hence, national development remains a by-product, while international development is always the central focus to which education primarily contributes [3]. Under such a climate, sustainable education for an emerging nation is merely a theory that stays far from the reality [4].

While local education is unable to compete in the era of globalisation, local elites often skim the cream off the top in education [1–3]. Hence, education has become one of the powerful tools that the elites can use to deprive underprivileged groups by introducing a "free market-driven theory" in education. This market-driven theory facilitates the development of a specialized, differentiated, and elite education program for the privileged group to widen the gap between the elite and poor, as the need for standardised or unified education is often denied by the policymakers and legislators in the emerging nations [4]. Poor people in emerging nations are often required to put in significant effort from an adverse and uneven condition to even access a free education locally available [5]. Hence, free education is also referred to as public education, which is the only shelter for the poor people and is becoming less effective over time. Under these circumstances, whether sustainable education in the era of internationalisation and commodification is a reality or an international political marvel is a question that needs to be addressed in the near future.

Sustainability in education either refers to those education programs that are capable of protecting the environment and ensuring the cautious usage of natural resources, or to the settings of educational institutes and their research arrangements with the alignment of the protection of the environment and natural resources [6]. In general, scientific-ism and modernisation are often blamed for damaging the genesis of the sustainability of nature, which will cause a grave adverse impact in the long run [6].

Institutions of education have expanded dramatically over the last two decades [5,6]. Hence, they are forced to adopt a market-responsive theory in order to survive in the era of modernisation and commodification [6]. The adoption of a market-responsive theory would surely halt the institutions of education to retain within the genesis of education philosophy. Consequently, sustainability in education might be another "lollipop" to keep the education system busy developing a big market for business without making a meaningful impact—a discourse which is yet to be explored.

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2. Undeniable Fact: Internationalisation and Commodification in Education

The tuition fees of a student studying in an international school in many parts of the globe (such as China, Malaysia, Korea, Hong Kong, UAE) are almost the same as a professor's salary in those countries [3]. The position of professor in an academic atmosphere. In order to reach a professorial stage, one not only has to show an exemplary success in his/her student life but also must display an illuminating performance in their academic career. Hence, a number of questions are generated: whom are the students studying in these schools? What are the aims and ambitions of these children after completion of their studentship career? How much money are these children are going to make after their education, and how will they make it? Would these children consider education as a philosophical program required for sustainable national development, or do they believe education is a commodity that they can use as a weapon to "kill" others for their own personal gain [1–3].

Moreover, the underprivileged students who cannot receive such an education might be inclined to take revenge if the scope arises [3]. In such a case, if someone from an underprivileged community became educated and reached an elite position in public service by overcoming inexplicable pains, might they be extremely corrupted to earn money to ensure the future of the children [1]. Hence, the following questions are generated: is this internationalisation and commodification in education an ally or enemy for sustainable national development? Should we label this as sustainable education even if it may bring a very specialised prospect for the elites?

Having said that, we may also need to note one of the important connotations—such international education delivered in China, Malaysia, UAE, and Korea is a national product of either USA, UK or Australia. Children in the USA, UK and Australia procure this education program as part of their national education program, which is free of cost. While this kind of education is very expensive in one part of the globe, the other supplies this free of cost. This may suggest that local education in the former countries may experience a huge "educational inflation" compared to the latter, thus leading to very high demand for international education within the local community of the former [2,3].

The above discussion might raise a graver concern regarding sustainable education, which subsequently has an implication for the sustainability in education. Under this climate, poor students would go to public schools that offer free education and that lack decent governance and regulatory control mechanism. Such a lack of governance and regulatory control not only interrupt the delivery of substantial education but also contribute to the misuse of resources such as water, electricity and land, which can be considered as a threat to sustainability in education [7,8].

This may add unnecessary expenses in education from the public exchequer. On the other hand, private schools might adopt a luxury theory in education which may ensure greater use of supplementary and complementary items in education (such as a swimming pool, theatre, amusement park, etc.) by squeezing the fundamental elements needed for sustainable education. This approach may help them to sell the education at a far higher cost compared to the production cost. However, this neither supports sustainable education nor ensures sustainability in education. The above discussions have highlighted the generic facts, so let us now focus on the issue of internationalisation and commodification in particular, with reference to higher education.

Internationalisation and Commodification in Higher Education

The generic effect of internationalisation and commodification exclusively helps the elites of emerging nations to access specialised/differentiated higher education for private interests and benefits by exploiting public gains. Ideally, higher education should shape the primary and secondary provisions as sustainable providers through its research and innovation—a common tenet suggests that it is not the elite-driven but merit-driven higher education system that support the concept of sustainable development in education. Hav-

ing said that, higher education provision predominantly experiences a number of graver concerns in connection to internationalisation and commodification.

Firstly, most of the universities in developing countries are yet to be hubs for research, innovation and knowledge discovery. Hence, they are reliant on the knowledge discovery made in their Western counterparts; subsequently, the courses curricula, expertise and delivery methods used in these Eastern universities are borrowed from their Western counterparts. This borrowing model, which is commonly known as internationalisation in higher education, has become entirely one-way traffic and trade, forcing higher education in emerging nations to assume the role of agent that serves the interests of the principal counterpart. Hence, whereas a university in the East supports local development in its function as an agent, its main role is to ensure the benefits of the West to a greater extent. Hence, studying in a local university does not necessarily mean that it will ensure exclusive local benefits. Consequently, internationalisation in higher education following one-way traffic may not result in a sustainable education system.

Secondly, the Sino–foreign cooperative model in higher education is well-evidently expanding with the prevailing local and international policy support. This international cooperation in higher education also suggests that the export and trade barrier in higher education is only removed for Western counterparts, as the higher education in the Eastern part of the globe has failed to take advantage of the GATS (General Agreement of Trade and Services) verdict that allows higher education as an international commodity.

Thirdly, a significant portion of students from developing nations often travels to the West to further their study, which may incur a direct loss of foreign currency. However, a decent lifestyle in the West, talent-based migration and social policy, and a true essence of internationalisation support the "push and pull theory", which motivates the talent to migrate to the West and to serve the interests of the destined location at the cost of his earned education by using the funds of the origin country. The portion of students who may return to their origin country after education may also serve as an agent of international development. Hence, internationalisation and commodification in higher education deserves much more attention in the era of sustainable education or sustainability in education.

3. A New Glimpse for Sustainable and Sustainability in Education

A significant number of specialised and differentiated studies has been conducted covering a wider spectrum in education (such as curriculum and instructional technology, teacher education, technology and innovation in education, school settings, education policy, best practice in education, international education and development, educational segmentation) to enrich the discourse of sustainable education and sustainability in education since their inception. All of these studies [7–11] claimed that the respective models are substantially helpful for sustainable education and sustainability in education. It is therefore acceptable to consider that these models have offered significant help to the development of education.

Despite these claims, education generally helps developed countries to rule over their developing counterparts, while on the other hand, the elites in developing countries skim the cream off the top in the era of internationalisation and commodification in education—this is an undeniable fact that receives less attention in the discourse of sustainable education [2,3,7]. The proposition that follows does not fundamentally propose a comprehensive solution for the problem raised; rather, it provides a glimpse so that future studies in this area can cover them broadly to present an extensive resolution.

Firstly, we propose that the standardisation of national education programs is the foremost need that the country has to plan. This standardisation should be determined in the alignment of a nation's economic and social developmental goals as well as a human needs perspective. Standardised education should be very competitive to challenge the international benchmark. Furthermore, standardised education must be homogeneous and unified to all students. Students' merits are the sole parameter for the selection of

education, not their socioeconomic status. All institutes of education are obliged to follow the concept of standardised education.

Secondly, the production cost of standardised education should be determined by scientifically calculating for each program, level, and type; subsequently, a selling price will be dogged by ensuring a minimum profit so that the educational institute is able to survive. The production cost of education should not be driven by the budget but should be determined by the standard of education targeted by the nation.

The budget for standardised education is to be ensured following the production cost that is determined by scientific calculation. All entities (public, private) of education should follow this principle regardless of the demands made by their customers. An increased or an artificial demand for education and, subsequently, an amplified but unproductive budget (both formal and informal) to meet such demand inevitably create a huge inflation for both investment in education and the qualifications provided.

Thirdly, the free school concept needs to be remodified and re-defined. Currently, the concept of free and paid education is determined by the entity/type of school (such as private, public, semi-public). Following this concept, an educational institute is no longer a common place for all children regardless of their SES; rather, a particular entity is designated for a specific economic cluster of children.

The free school concept should be re-defined, whereby education will be free for the "needy" based on their needs. Education expenses include both direct and indirect costs. Moreover, some ultra-poor groups (especially those who are bound to be the child labour needed to survive) need additional support to continue their education, which should be labelled as 100% + free education. Some students might not need additional support but do need the support for both direct and indirect costs, which is to be called 100% free. Hence, both 100% +/− free concept and 100% +/− paid concept are to be introduced and reinforced.

This concept will not be implemented by the school entity but by the SES of the students. Here, the government subsidy will be provided to the children according to the SES through a voucher-based system or any other considerable method(s) based on further research. The students would be able to use this voucher regardless of their school entity. The financially able students need to pay regardless of the type/entity of school that they may attend. This is how a substantial investment model based on a particular nation's educational needs is to be incorporated for the collective and public interest.

Fourthly, both the public and private return from education needs to be re-mechanised. Upon employment of graduates, a differentiated and specialised taxation mechanism should be in place so that the government can cover the subsidy that has already been used for a particular group's education. Hence, two graduates (i.e., one graduate with a subsidy and one without) having the same kind of qualification and same level of income range should pay differentiated tax so that the underprivileged students (who enjoy 100% +/− free education) do not have much leverage to consider that the subsidy is granted forever. While the above agenda is generally applicable for the education system as a whole, the next paragraph spotlights a specialised item for higher education.

In order to improve the efficacy of higher education, an industry-driven system is acutely needed as higher education supplies its graduates to the industry. Meaningful industry participation for both curriculum development process and delivery as well as assessment of higher education needs to be ensured. A substantial and scientifically well regulated industry levy system may ensure significant industry participation in higher education. Students should not just enjoy a scope of pre-paid tuition fees but may be able to use a post-paid fees mechanism where the university would collect the fees directly from the employing industry on behalf of its employed graduates. This approach would oblige both demand and supply sides to invest a collaborative effort in order to ensure a sustainable higher education which is capable of contributing to both public and private benefits.

This approach would force them not to be lethargic in the competition of education. On the other hand, introducing a 100% +/− fees model for financially able students will de-

motivate them (i.e., those students who are less academically capable) and not to disbalance the education system, since this revised education system would allow the financially poor but academically able students to defeat the less academically capable students in the entire journey of education. If both the investments in education and returns from education are not regulated as public goods and in the interest of the public, sustainable education would remain a nightmare for the emerging nation and exist only in theory. In the absence of sustainable education, resources in education should typically experience huge wastage or misuse and would thereby contribute to educational inflation. Consequently, sustainable education serves as the prerequisite for sustainability in education.

4. Thematic Highlights from the SI's Papers: Concluding Remark

Before summarising the substance of this SI, let us highlight some collective themes from the different clusters of the published papers. Of the published papers, five [9,11–13] have explored academic and teacher education perspectives. Each paper develops its rationale by accepting that academic excellence is not up to the mark in emerging nations. In solving such a crisis, Refs. [9,11] suggested that academics should abide by the philosophy of education, particularly higher education, while [12,13] advocated in favour of the adaptation of technology in teaching and learning affairs and the provision of policy preference for such interventions.

Five papers [8,14–16] have explored the issue of sustainable innovation in higher education. One of the common issues faced in rationalising the study, as each paper has acknowledged, is that a significant space for innovation has remained vacated. In offering a resolution, refs. [8,14] have argued that the institutes of higher education have to be the role model in implementing sustainable innovation before they are able to transmit this into their own society, while [14,15] advocated that sustainable innovation is a collective effort that must be driven by all of the stakeholders involved.

Five papers [7,10,14,17,18] have explored the role of public and private provisions in delivering sustainable higher education by comparing the strength and weaknesses of each counterpart. One of the common propositions suggests that public system misuses the budgets via different forms of corruption, while their private counterparts squeeze the resources for profits. A scientific model to resolve such problems for private counterparts is suggested by [7], while [10,14,17,18] advocated that both public and private provisions must understand the reality that higher education experiences in the 21st century without compromising the philosophy of higher education. Having said that, each paper, regardless of its context, argued that universities in emerging nations are lagging behind in the international ranking league table of sustainable higher education, and the prescription provided in the study would support the push to improve the position of these universities in the international competition league.

The successful submissions in this Special Issue have not just covered a narrow field in the area of sustainable education and sustainability in education. Rather, the publications have covered various angles and aspects related to the theme. These publications suggest that innovation and technology are not sufficient to combat the challenges involved in sustainable education and sustainability in education unless the root causes are identified and preventative measures are subsequently taken. We also realised that although sustainability in education and sustainable education are two different concepts, the distinction between them is not often acknowledged.

A misleading distinction, without identifying the root causes, is also occasionally made to define and to demarcate sustainable education and sustainability in education. Moreover, research is lacking in the discovery of the connecting point between sustainable education and sustainability in education. Hence, to have focused attention, a new Special Issue entitled "Sustainable Education and Sustainability in Education: Policy and Implementation Direction in the Era of SDGs" is developed under the section of "Sustainable Education and Approaches" in *Sustainability*, where new submissions are welcomed.

5. Further Readings

1. Special Issue "Sustainable Education and Sustainability in Education: Policy and Implementation Direction in the Era of SDGs". Available online: https://www.mdpi.com/journal/sustainability/special_issues/Q462Y110A0 (accessed on 25 December 2022).
2. Special Issue "Approach and Policy in Higher Education for Sustainability". Available online: https://www.mdpi.com/journal/sustainability/special_issues/Higher_Education_Sustainability (accessed on 25 December 2022).

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References

1. Sterling, S. Sustainable Education Revisioning Learning and Change, Schumacher Briefing no6. In *Schumacher Society/Green Books*; Dartington: Totnes, UK, 2001.
2. Alam, G.M. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef] [PubMed]
3. Alam, G.M.; Forhad, M.A.R.; Ismi, A. Can education as an 'International Commodity' be the backbone or cane of a nation in the era of fourth industrial revolution?—A Comparative study. *Technol. Forecast. Soc. Chang.* **2020**, *159*, 120184. [CrossRef]
4. Niu, D.; Jiang, D.; Li, F. Higher education for sustainable development in China. *Int. J. Sustain. High. Educ.* **2010**, *11*, 153–162. [CrossRef]
5. Alam, G.M.; Parvin, M. Three parameters of urban K-8 education during pre- and post-covid-19 restrictions: Comparison of students of slums, tin-sheds and flats in Bangladesh. *Educ. Urban Soc.* **2022**, 00131245221086277. [CrossRef]
6. Dale, A.; Newman, L. Sustainable development, education and literacy. *Int. J. Sustain. High. Educ.* **2005**, *6*, 351–362. [CrossRef]
7. Alam, G.M. The Relationship between Figureheads and Managerial Leaders in the Private University Sector: A Decentralised, Competency-Based Leadership Model for Sustainable Higher Education. *Sustainability* **2022**, *14*, 12279. [CrossRef]
8. Grigoryeva, M.; Dmitrevskaya, I.; Belopukhov, S.; Osipova, A. The Chemical Training of Agrarian Specialists: From the Chemicalization of Agriculture to Green Technologies. *Sustainability* **2022**, *14*, 8062. [CrossRef]
9. Ma, X.; Gryshova, I.; Koshkalda, I.; Suska, A.; Gryshova, R.; Riasnianska, A.; Tupchii, O. Necessity of Post-War Renewal of University Teachers' Potential in Terms of Sustainable Development in Ukraine. *Sustainability* **2022**, *14*, 12598. [CrossRef]
10. Li, J.; Xue, E. Pursuing Sustainable Higher Education Admission Policy Reform: Evidence from Stakeholders' Perceptions in China's Pilot Provinces. *Sustainability* **2022**, *14*, 11936. [CrossRef]
11. Chen, S.; Wang, R.; Wang, T.; Zhou, W. The Impact of Student-Teacher Policy Perception on Employment Intentions in Rural Schools for Educational Sustainable Development Based on Push–Pull Theory: An Empirical Study from China. *Sustainability* **2022**, *14*, 6639. [CrossRef]
12. Uaciquete, A.S.; Valcke, M. Strengthening the Teaching and Research Nexus (TRN) in Higher Education (HE): Systematic Review of Reviews. *Sustainability* **2022**, *14*, 15317. [CrossRef]
13. Ma, G.; Shi, W.; Hou, P. Exploring University Teacher Construction for Higher Education Sustainability in China: Perspective from Policy Instruments. *Sustainability* **2023**, *15*, 362. [CrossRef]
14. Li, J.; Xue, E. A Social Networking Analysis of Education Policies of Creating World-Class Universities for Higher Education Sustainability in China. *Sustainability* **2022**, *14*, 10243. [CrossRef]
15. Ong, A.K.S. A Machine Learning Ensemble Approach for Predicting Factors Affecting STEM Students' Future Intention to Enroll in Chemistry-Related Courses. *Sustainability* **2022**, *14*, 16041. [CrossRef]
16. Damico, A.B.; Masi, M.; Aulicino, J.M.; Vecchio, Y.; Di Pasquale, J. The Knowledge and Perception of Sustainability in Livestock Systems: Evidence from Future Professionals in Italy and Argentina. *Sustainability* **2022**, *14*, 16042. [CrossRef]
17. Forhad, M.A.R.; Alam, G.M.; Rashid, M.; Haque, A.; Khan, M.S. Sustainable Development in Higher Engineering Education: A Comparative Study between Private and Public Polytechnics. *Sustainability* **2022**, *14*, 8094. [CrossRef]
18. Yu, L.; Yan, Y.; Li, M. Does Interdisciplinary Research Lead to Higher Faculty Performance? Evidence from an Accelerated Research University in China. *Sustainability* **2022**, *14*, 13977. [CrossRef]

Short Biography of Author

Professor Gazi Mahabubul Alam, PhD, FRSA is an internationally recognized Public Policy Analyst with a particular focus on Higher Education. Countries of his work experience include Malaysia, Bangladesh, UK and the USA. He works for both the institute of Higher Education and Partner for Development. Before he moved to the University Putra Malaysia, he was a professor at the University of Malaya and East West University. Further to his postgraduate degree in Business Administration, Alam acquired an MA in International Education and Development from the University of Sussex and a PhD from the University of Nottingham. He received a distinguished fellowship from the Royal Society of Arts. He has published a number of papers, and they received a notable number of citations in the Scopus and ISI indexed. His paper on private Higher Education received the Best Citation award from the Web of Science.

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Article

The Relationship between Figureheads and Managerial Leaders in the Private University Sector: A Decentralised, Competency-Based Leadership Model for Sustainable Higher Education

Gazi Mahabubul Alam

Department of Foundation of Education, Faculty of Educational Studies, University Putra Malaysia, Serdang 43300, Selangor, Malaysia; gazimalamb@yahoo.com

Abstract: Using school management settings, important substantial leadership models (such as "instructional", "constructive", and "distributed") are developed. University leadership, especially in the private sector, is an understudied topic. While private universities need to generate revenue for profits and survival, they should at the same time retain a sound education philosophy—an extremely difficult task. Studies are yet to be conducted to understand how leaders of private universities handle this challenge, and this issue motivates the present study. Using Bangladesh as a case study, this qualitative analysis discovers that the "visionary" leadership approach is mainly used for the business management models that governs private-sector universities. This does not allow an established education leadership model to function well, if at all. This has seriously challenged education philosophy. Innovation of a specialised private-sector university leadership model is therefore required. A "distributed leadership" approach is the latest innovation for educational leadership, which is mainly applicable for the public system, especially for K12 provision. Considering a distinct operational norm of the private university sector in a developing nation, this research suggests a dynamic revenue-collection model which would enable the development of a decentralised, competency-based leadership approach. While the private university sector may not be able to implement "distributed leadership" model given the operational differences and challenges involved, the proposed model may support the private university sector to function in tertiary level, as the "distributed model" functions for K12 provision. This proposed model (decentralised, competency-based leadership) would further be able to ensure a specialised operational directive for private universities in an emerging nation that may ensure a distinctive nature for the sector's delivery of sustainable higher education (HE) without compromising the philosophy and role of HE.

Keywords: leadership models; competency-based leadership; visionary leadership; business leadership; private-sector university; sustainable higher education; education philosophy

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1. Introduction

Managerial leadership—often referred to as a formal arrangement—not only runs regular affairs but also develops strategy and policy directions so that a system/institution is able to combat the further challenges it may encounter for its business routine in the future. On the other hand, leadership figureheads endorse pragmatic strategic and policy directions, as designed by the managerial leaders. Despite managerial leadership which incorporates the governmental/management running of both a country and its major institutions, "figurehead" leadership prevails in many scenarios [1]. For example, the UK and Malaysian governments both have democratic leadership with a "ritualistic" queen or king. This scenario is also evident in the education system [2]. For example, some countries' university management teams are actually headed and controlled by vice-chancellors (VCs), while chancellors serve as "figureheads".

A working relationship between the "figurehead" and managerial leaders has to develop well so that an institution can function properly [3]. The board of trustees (BoT) has recently emerged in some countries' private university governance systems where entrepreneur-type ideas are encouraged [4]. Ref. [5] argued that, despite introducing a BoT, management structures generally do not officially allow entrepreneurs to lead them. Private university management legally includes VCs, pro-VCs, deans, and department heads, and official regulations do not welcome entrepreneurial influence.

The lack of official recognition may theoretically turn BoTs into a "figurehead" body [5]. Despite the "figurehead" role, BoT idyllically control a university without adhering to the official rules since they may desire to have profits from their investment [5]. The debate on whether the regulations that ignore entrepreneurs' involvement in management issues are pragmatic is an ongoing one [5]. In these circumstances, conflicts between a "figurehead" and the managerial leadership figures are bound to occur [5].

Research Gap and Scope: Objective and Questions

Since its inception, the private university sector's growth has been dramatic, and statistics show that it shares 77% and 72% of total universities in Southern Asia and Sub-Sharan Africa, respectively. These universities hold 44% and 39% of the total student population, respectively [6]. Although private universities are relatively small in comparison with public-sector universities, the sector plays an important role [7]. In this paper, a literature review describes the leadership challenges that private-sector universities encounter. The following discussion expresses this study's motivation. A few studies on private university leadership [8–12] have explored the relationship between leadership and job satisfaction or student satisfaction.

Private university leadership success is measured by business success, profit-driven funding, and its linkage with education programmes, degrees, etc., as shown in [3,4]. Empirical studies to understand the link between a "figurehead" and the managerial leadership team in private universities and the overall impact of this link have yet to be conducted [5]. This study addresses the question of whether the link between a "figurehead" and the managerial leadership team is uneven in the absence of a viable leadership mechanism.

In pursuit of this aim, the objectives of this study are to: (i) understand the relationship between the "figurehead" and the managerial leadership team; (ii) explore the influence of "figurehead" leadership on management; and (iii) determine the leadership that makes a difference in terms of business success. The following research questions are stated to get to the heart of the matter:

How does the relationship between a "figurehead" and the managerial leadership team work?
How does this relationship influence business success?
Do the principles in education or the goal of business drive success?

Principles in education and the goal of a business often exist in isolation. The above-raised questions are thus fundamentally important to investigate. One of the most difficult challenges facing private education is finding a balance between the principles in education and the goal of the business. It is the responsibility of the university leaders to navigate and resolve this complex assignment. Hence, this study, which was conducted in Bangladesh as an example of a developing nation, offers an important contribution to the discussion of the leadership of the private university sector.

Having expressed our introductory statement, this literature review highlights the dynamics of educational leadership and the challenges involved for the leaders in the private university sector. This review also highlights the comparative significance of this research. Prior to explaining the research design, relevant information of the research context is provided. Before presenting our concluding remarks, our findings and discussions are reported.

2. Literature Review

Firstly, the concept of "figurehead" as an aspect of leadership and its implications for education are explained. Before describing the private university sector's development and its leadership challenges, changes in educational leadership are explained in more detail.

2.1. Genesis of "Figurehead" Leadership: Implications for Education

The discourse on "figurehead" leadership is not well-represented in the literature [3]. The established criteria for "figurehead" leadership have a long history within national government, institutional governance, and management practices. The authors of [3] argued that "figurehead" leadership is not a "gift" but an achievement. For instance, in the UK, the royal family is the "figurehead" of the government and is directly linked to the historic contributions of the royal families to the British Empire.

Ref. [1] argued that global leadership culture was initially cultivated by the British "royalist" approach, which might be currently irrelevant, due to the rise of the "diplomatic" approach in global leadership. Some countries' "figurehead" leadership, as retained by the "royalists", is not just a gift—it is a recompense of achievements [3]. Initially, many countries' education systems were not at the forefront of government or public policy. Community participation and philanthropic contributions marked the "genesis of some countries' educational development" in some cases [13]. Philanthropists—either religiously or philosophically motivated—contributed to education before it became part of public/government policy [14].

To respect "philanthropists' contribution" and to confirm educational institutions' adherence to various viewpoints, the concept of "figurehead" leadership was introduced [11]. For instance, "philanthropists" often sat on schools' governing bodies, councils, etc., while the headmaster led the management and presided over rules and regulations. Community participation turned education into a social product. The growing popularity of and demand for education motivated politicians and bureaucrats to establish education institutions that grew under the aegis of public policy [14]. To promote political ideology or activities, politicians and bureaucrats began dominating the governing bodies of institutions [15]. This shattered the once-strong bond between the "figurehead" and the managerial leadership [16]. To assure worthwhile outcomes, studies focused on establishing practical education leadership models [17]. Since then, many educational leadership transformations have emerged; these are explained below.

2.2. Transformations in Educational Leadership

Many countries' education systems were introduced by a process known as the "guru" and "shishya"—a commonly used religious teaching model that involves one-to-one coaching or teaching. In the era of the "guru" and "shishya", "solo leadership"-guided education management evolved [18]. Educational administration followed the "bureaucratic leadership" model, which was introduced after education became a matter of public policy [19] and then turned into a system of "educational management" [20].

The fundamental distinction between "educational administration" and "educational management" is that the former saw education as a developmental tool, while the latter considered education as the key to economic and social development [17]. Educational management as a concept became widely accepted as a response to the holistic view that led to several leadership transformations [21]. "Changed", "transformational", and "contingent" leadership models were predominantly used during the educational management era [22].

Ref. [22] argued that no model is complete or answers all the questions; however, each model has particular strengths and weaknesses, which are influenced by the context it investigates. These models are not "authoritarian" but "authoritative" in nature and they generate collective and coordinated management strategies [23].

"Vision" is fundamental for effective education management and leadership [22,24]. Whilst various schools and their leaders may embrace differentiated and specialised visions,

a country's education policy is a different matter [16]. Several types and patterns of schools with various ownership modalities have existed for at least the last four decades [5]. In order to fit schools into a single framework for achieving a national education policy, education management has been rebranded as educational leadership [16].

"Instructional", "constructive", and "distributed" models have emerged as part of the educational leadership concept of the 21st century [2,25]. Refs. [26,27] argued that these models are distinct, although they may supplement and complement each other because "one-size does not fit all". With reference to the "humanitarian view", business-motivated education is neither culturally nor officially accepted, which adds to the challenges for leadership to consider in the era of "commodification in education" [6]. The following subsection explains the challenges that the leadership in education experiences when education is considered as a business product/commodity—commodification of education is considered to be threat to sustainable education [6].

2.3. Transformation of University Philosophy: Challenges for Private University Leadership

Ref. [28] asserted that a university's purpose is to create "elite leaders" to run a country, and in this way to gain international prestige and influence. Challenging the "orthodox view" presented in [28], universities learnt the importance of a knowledge-driven society because such a society helps to prepare leaders in many fields of endeavour [29]. Therefore, a university's mission should develop and distribute information and skills in interdisciplinary fields for national and global purposes [30]. The authors of [30] further suggest that information, knowledge, and innovation have both positive and negative outcomes.

Both "commercialisation of knowledge" and "commercial knowledge" contribute more negatively. In this view, the private sector's participation in higher education was criticised and repudiated [5]. Although universities fail to provide a concrete definition of knowledge, knowledge delivered by universities contributes to economic development [30]. Publications and degrees measure the level of knowledge that an individual possesses [6].

University degrees provide private benefits that have implications for the university, employment/industry, and the wider society [31]. This view supported the rise of the private university sector [14]. The "Neoliberalism" concept has further expanded private sector higher education [31]. Whether knowledge should be used for social benefit or for private gains is an unsettled debate [30].

Despite the growth of private universities that view knowledge as a private good, their governance and management models are public sector institutions [4]. Because higher education is a public good, public university governance and administration structures were created to be inapplicable in the private domain [4]. Despite the unresolved argument, developing countries saw the benefits of private universities [5]. The ownership model recognises a few types of private universities (corporate house, religious group, scientific society, education business).

A company's mission, policies, and resolve should be led by its owners [4]. Many private institutions in developing countries overlook owners because their processes are drawn from the public sector, where ownership is a totally different concept [5]. In the absence of legal entity or directive, private universities' owners control managerial and leadership affairs in their own way [32,33].

An "ownership pattern" greatly influences an organisation's vision, which subsequently influences their achievements [22]. Whether institutions are producing and disseminating knowledge (the mission of private universities) or exploiting knowledge for "commercial gains" (by using a brand) is a question that should be answered given the current era's commodification of knowledge and education [32].

Although private universities' intentions may differ based on ownership type, all kinds fundamentally consider knowledge as a "commercial product" for making profits and for their economic survival [4]. Ideally, this would drive private universities to abandon their educational leadership approach and adopt a business leadership one [10]. This threatens universities' uniqueness by causing the "diploma-disease" and "publication-

disease" crises [31]. Either the old relationship between "figurehead" and managerial leaderships "failed", or a new, market-driven one emerged. Market-driven leadership approaches in education may not deliver [10]. Therefore, an effective private university leadership model is critical. Since private education—especially university provision—is a global phenomenon, we hence note the international relevance of this paper, which is particularly applicable for emerging nations.

2.4. International Comparative Significance

This study was performed within the context of the Bangladesh private university sector. A description of the research context is provided before a justification of the accurateness of the research design adopted. Prior to explaining the research context, let us note the international significance of this research.

The criteria of higher education institutions (such as "man as man" approaches, land-grants, machine grants, and delivery modes) and their schemata (such as universities, polytechnics, specialised institutions) have evolved out of historical practice [6,34]. For example, "man as man" delivery, which is the genesis of higher education, refers to the universities that fundamentally focus on the cognitive programs. Land grants and machine grants are delivery modes that are relatively newer phenomena, focusing on engineering and agriculture programs, respectively. The history of universities reveals that higher education originated in the Middle East and later travelled to Europe and to the United States before expanding to a wider international market [34]. Higher education in the British colonial regions was also established following the settings of Great Britain's model [35].

Although higher education has experienced several paradigm transformations since its inception, public provision was the primary motivation for valuing higher education as a public good [36]. Consequently, management structures, governance processes, and leadership models were established for universities following the norms of a public sector with a particular reference to the British model [37].

The USA was the first nation to inaugurate a private higher education sector in order to generate multiple sources of revenue and to ensure the accountability of higher education amongst the different stakeholders involved [37]. Japan was one of the foremost nations that copied the private higher education model of the USA. Since then, universities, especially private universities, saw decentralised management and leadership structures in some settings [38]. The private university sectors in the USA and in Japan are not commercially driven but are market-responsive sectors [6].

This market-responsive private higher education system has helped both the USA and Japan to make significant progress in their national development [6]. Consequently, many former British colonial states borrowed a number of educational programmes from the USA soon after they gained independence [38]. Although these universities copied educational programmes from higher education in the USA, the management and leadership models were not necessarily transformed into USA models, because most of them followed the management structure that was developed during British chastisement [6].

Following the GATS agreement prescribed by the WTO, many developing nations introduced private university sectors in the early 1990s, which are—theoretically—not-for-profit entities [39]. Ideally, private universities in these nations are commercial initiatives that predominantly depend on a single source of funds, namely tuition fees [6]. Furthermore, these private universities officially follow the management and leadership mechanisms which were set up for the public university sector during the colonial era [40]. Most Asian and African private universities that follow colonial management and leadership models experience similar challenges [6]. Therefore, this study has potential to present some meaningful insights which might benefit a number of nations that share common features in the development of their private university sectors.

3. Research Context

Without highlighting the generic facts and figures which are available in earlier studies [15,31], we describe—with reference to Bangladesh—the rise of the private university sector, its ownership pattern, and its governance procedures.

3.1. Private University Sector: Nature of Ownership

The legislation known as PUA-1992 (Private University Act) is said to have "annihilated" the public sector university system. Upon the introduction of PUA-1992, two universities were immediately established in Bangladesh. One of them was owned by businessmen and the other was initiated by an academic who was a political ally of the party that was then in government [5]. Since 1992, the expansion of the private university sector has been dramatic [5]. Ref. [5] noted that 111 private universities were established following the eight stages of political progress in Bangladesh.

A legal document published by the University Grants Commission (UGC) suggested that the term "owner" in relation to a university is illegal. However, many UGC documents have in fact employed this term on several occasions. "Self-proclaimed" private university ownership is diverse. According to [13], there are eight main categories for these diversified ownership patterns: corporate house—CH; family business—FB; collaboration amongst businessmen—CaB; non-governmental organisation—NGO; religious group—RG; alliance between academics, businessmen, and politicians—AABP; public corporation—PC; education company ownership—ECO).

Business companies owned by families may run universities and these are labelled as CH. Of 111 universities in Bangladesh, 19%, 8%, 9%, 9%, 3%, 40%, 4%, and 8% are held by CH, FB, CaB, NGO, RG, AABP, PC, and ECO ownership patterns, respectively (Figure 1); these university categories hold 27.7%, 14.1%, 21.7%, 7.8%, 2.5%, 18%, 1.5%, and 6.8% of the country's student population, respectively (Figure 1).

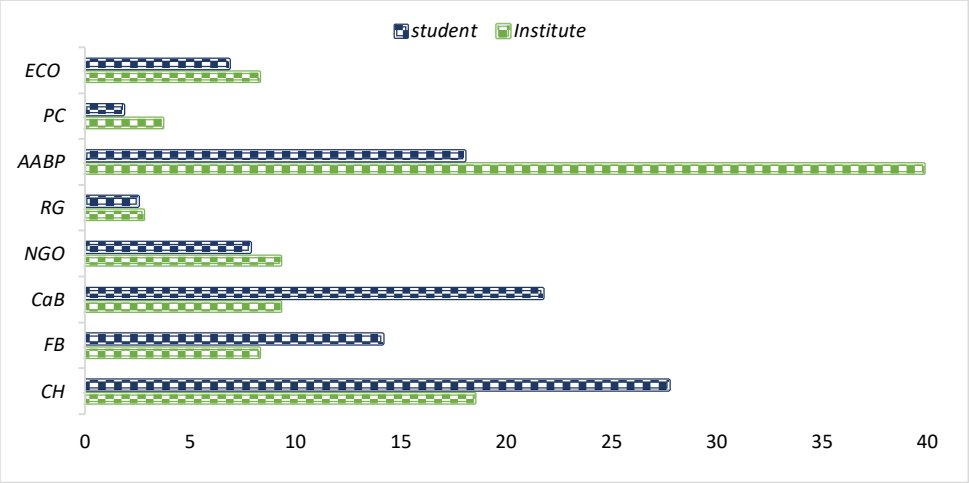


Figure 1. Percentages of eight types of universities and their students. Horizontal and vertical axes represent percentage sharing and university type, respectively.

3.2. Governance and Leadership

PUA-2010 is the latest legislation superseding PUA-1992. A private university "must be regulated" according to PUA-2010, which was reworded to ensure "entrepreneurs' involvement" in "governance and leadership". Comparing PUA-2010 with public university regulations, the authors of [5] argued that no fundamental differences exist within the governance procedures for public and private sectors. Both sectors' management systems comprise VCs, pro-VCs, deans/directors, and departmental heads. Management is generally recruited in both sectors following the same official procedures.

Three bodies, namely the senate, syndicate, and academic council, assist management in endorsing strategic and policy decisions. A BoT is an additional and exclusive advisory body that helps private universities. Whether the regulations of a given BoT allow entrepreneurs to lead universities is examined below. PUA-2010 includes nine clauses in its section on the function of the BoT. Two clauses suggest the numbers and eligibility criteria required for BoT members, and this was not an aspect of PUA-1992. "Entrepreneurs can be engaged as BoT member" is documented in PUA-2010.

The management parties (VC, pro-VC, and treasurer) of both public and private sectors are appointed by a chancellor. Further clauses suggest that the BoT "must NOT" appoint management but should recommend names to the chancellor. This implies that the role of a BoT is that of a "figurehead". Clauses that expressed the obligations of a BoT suggest that the BoT is "bound to arrange" funds and resources to establish the university. PUA-2010 noted that a private university is a "not-for-profit organisation". Moreover, BoT members "must NOT enjoy" any financial or non-financial benefits except "meetings' allowances". Elements in the text that allow "entrepreneurs" to take on more assertive leadership roles are absent.

Discussion may also show that private university ownership patterns may not fit the "philanthropic model". So why do entrepreneurs take on such significant financial and personal risks to run private universities? This question is important since the BoT has the power to intervene in management affairs. This gives the BoT infinite power and makes the chairmanship the most profitable position. In this case, charting the relationship between a "figurehead" and the managerial leadership team is critical. In this aim, the research design chosen for this study is explained in Section 4.

4. Research Design

Here, the reasons for choosing a qualitative method are presented before the data collection, data analysis, and sampling procedures are explained. Ethical issues are reported as well.

4.1. Methodological Approach: Justification for the Qualitative Method

Recent studies in education leadership have considered using both qualitative and quantitative methods; however, the qualitative approach has been exclusively adopted during the inception phase of research in educational leadership [41]. Qualitative studies present various education leadership models (such as "instructional", "transformational", and "distributed") with defined/identified variables for testing their efficacy [23,25]. This may make it possible to draw causal relationships amongst models/variables adopting quantitative techniques [41]. Despite the acceptance of both methods, the qualitative approach is suggested to be the best fit for educational leadership studies that hold new norms [41].

Firstly, given the new norms of private university leadership, this study selected a qualitative method that includes primary data via interviews and secondary statistics collected via a literature review. As a part of the qualitative study, a descriptive analysis of these statistics was performed using percentages—this does not represent a quantitative model/analysis technique. Secondly, the private university sector's growth and its ownership pattern follow neither a "prearranged plan" nor a targeted, well-practiced educational governance and leadership model. Subsequently, utilising a mathematical or statistical model was simply impossible for this research. Given the nature of the research question, we used an individualistic approach to select tools which accumulated both secondary and primary source data (Table 1). The secondary data—collected via literature review—were analysed before collecting the primary data, so that relevant interview questions could be properly prepared [42].

Table 1. Data-collection tools for individual RQs.

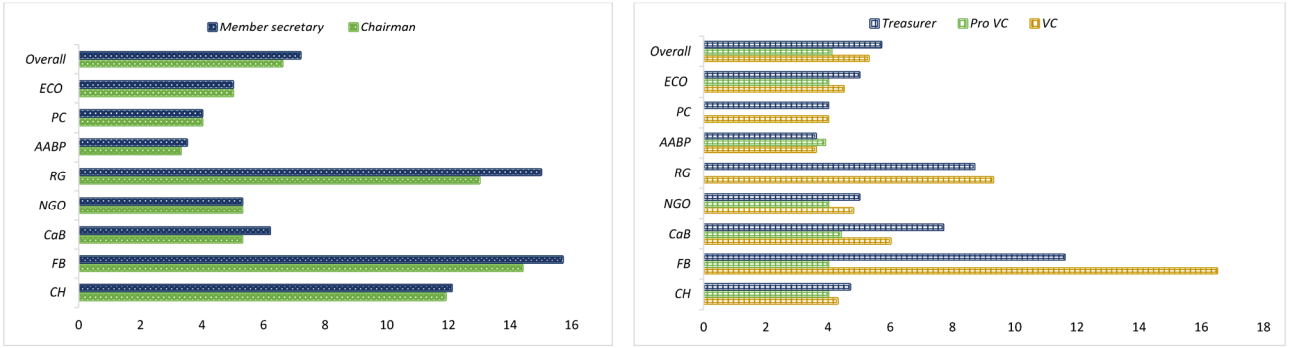
RQ	Primary Tool(s)	Auxiliary Tool(s)	Method
How is the relationship between figurehead and managerial leadership established?	Document reviews	Interviews	Qualitative
How does this relationship influence business success?	Interviews	Document review	Qualitative
Does education philosophy or business motives drive success?	Interviews	Literature review, interpretation of the findings, and discussion of earlier research questions	Qualitative

4.2. Domains' (Instrument) Development: Secondary Data Collection, Analysis, and Reliability

Secondary data that represent all private universities were gathered from UGC annual reports published during 1994–2019. Private universities supply material in a prescribed format. Annual reports list each university separately. We tracked a university's progress since its inception. Data surrounding student numbers, management, and financial turnover were collected under four key domains. Further subdomains were created to understand the length of time that an individual occupies two prime positions, namely chairperson and secretary.

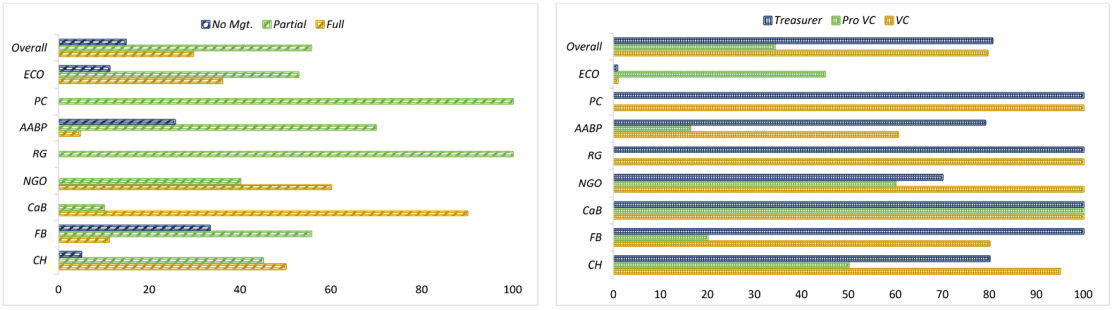
Domains, specifically the full-management, partial-management, and no-management domains, were created to understand management status, since [5] noted that many private-sector universities often did not have full-time management and in fact combine three positions into one. For example, one academic serving as VC also holds other positions (pro-VC, dean, treasurer) at the same time. Similarly, further domains of management were created to understand the length of time that an individual occupies the positions in management (VC, pro-VC, and treasurer). Data of each domain and subdomain were compared amongst eight types of university to understand the relationship between the BoT and management.

Data on student numbers, financial turnover, and campus status were compared to understand university business sizes. We compared the averages of the eight university types based on the data from each domain. Figures 2–5 show these comparisons. These data are "heterogeneous" in nature and are not based on opinions or scores. Actual "facts and incidents" are the sources of these data. In such a situation, an average value can be considered without connecting the mean, median, or standard deviation values [43]. As suggested by [44], we used "descriptive analysis" in the event of an extreme data "heterogeneity", where different statistical models (linear, logistic, multiple regression, and SEM) may not function properly.



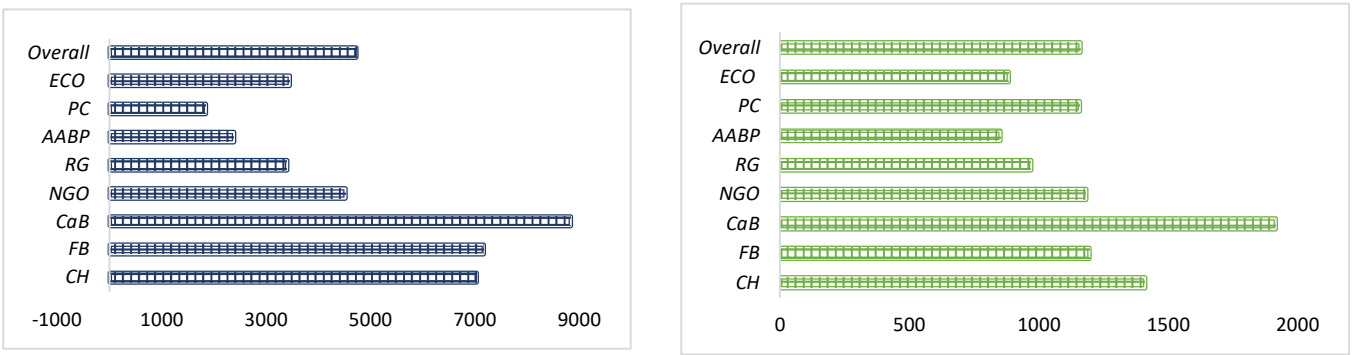
(**Panel A**) (**Panel B**)

Figure 2. Average length (year) of position held in BoT (chairperson, secretary) and management (VC, pro-VC, treasurer) in eight types of university. **Panel A**: Average length (year) of BoT positions. Horizontal and vertical axes represent length and university type, respectively. **Panel B**: Average length (year) of management positions. Horizontal and vertical axes represent length and university type, respectively.

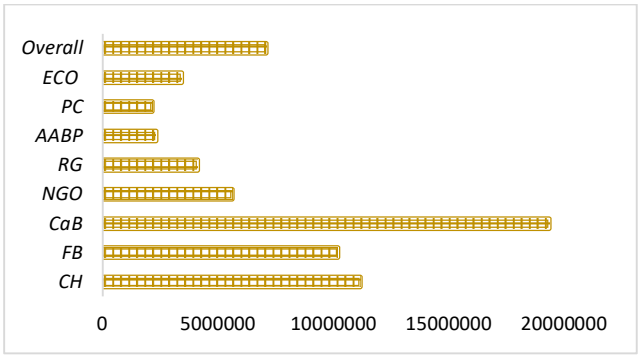


(Panel A) **(Panel B)**

Figure 3. Management structure in eight university types. **Panel A**: Percentages of full-, partial-, and no-management positions. Horizontal and vertical axes represent percentage sharing and university type, respectively. **Panel B**: Percentage of positions held (VC, pro-VC, treasurer). Horizontal and vertical axes represent percentage sharing and university type, respectively.



(Panel A) **(Panel B)**



(Panel C)

Figure 4. Average number of students, per student cost (in USD) and financial turnover (in USD) in eight types of university. **Panel A**: Number of students. Horizontal and vertical axes represent number of students and university type, respectively. **Panel B**: Costs per student. Horizontal and vertical axes represent per student cost and university type, respectively. **Panel C**: Financial turnover. Horizontal and vertical axes represent turnover and university type, respectively.

4.3. Sampling and Triangulation for Interviews: Primary Data

In addition to secondary data, the BoT, management, academia, and students were sampled for interviews to generate the required data. To perform triangulation effectively, respondents were considered from eight types of university (CH, FB, CaB, NGO, RG, AABP, PC, and ECO). To moderately value a proportional sharing concept, 3, 2, 2, 2, 1, 5, 1, and 2 universities were selected from the CH, FB, CaB, NGO, RG, AABP, PC, and ECO university types, respectively. Details of university type were provided in the presentation

of research context (Section 3), and these were used to develop the basis of the triangulation.

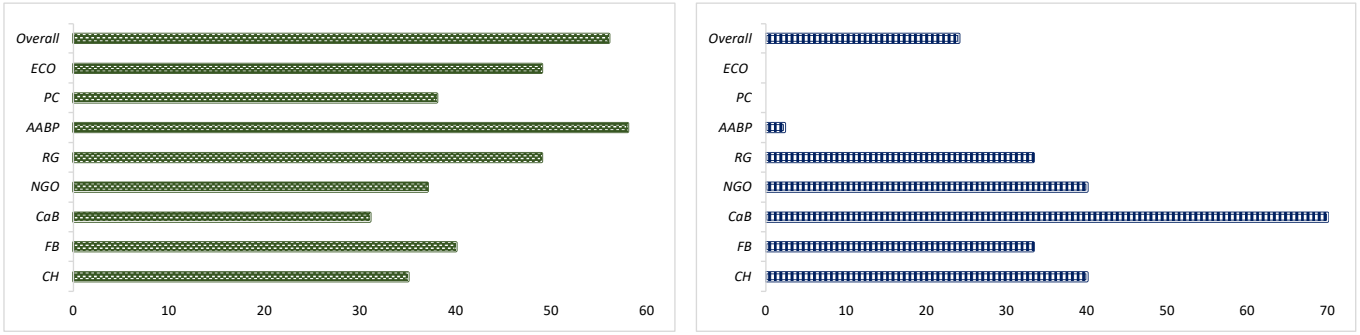


Figure 5. Academic–student ratio and permanent campus status in eight types of university. **Panel A**: Academic–student ratio. Horizontal and vertical axes, respectively, represent the ratio (1 teacher: x student) and university type. **Panel B**: Permanent campus status. Horizontal and vertical axes represent percentage sharing and university type, respectively.

We interviewed one individual from BoT and management, respectively, while two academics and students were interviewed from each sampled university (Table 2). Furthermore, four groups of respondents—BoT, management, academics, and students—were interviewed since they are the key stakeholders whose collaborative efforts are essential for the functioning and achievements of universities. Respondents across the universities were taken into account to check whether similar or various difficulties/challenges were encountered, since studies on leadership demand "multiangled" perspectives on certain issues [1]. The Minister of Education and the senior officials of UGC declined our requests for interviews.

Table 2. Sample and sampling.

Type of University Based on Ownership	University Number	BoT	Management	Academics	Students	Total Respondents
CH	3	3	3	6	6	**18**
FB	2	2	2	4	4	**12**
CaB	2	2	2	4	4	**12**
NGO	2	2	2	4	4	**12**
RG	1	1	1	2	2	**6**
AABP	5	5	5	10	10	**30**
PC	1	1	1	2	2	**6**
ECO	2	2	2	4	4	**12**
Total	**18**	**18**	**18**	**36**	**36**	**108**

4.4. Primary Data Collection, Analysis: Confidentiality and Coding

Trial interviews with colleagues helped us realise the necessity of asking more questions based on their replies in the final interviews, as indicated by [42]. So, the final interviews were semi-structured. The interviews had four phases. Initially, the interviews were started with rapport-building questions (for example, question 1—"How long have you been in your academic career?"; question 2—"May we ask for more information about your exemplary career as an academic leader?"; question 3—"What are the factors that drive you to be an academic leader?"; question 4—"What are the challenging and remarkable experiences that you have had as an academic leader, which you are and happy to share with us?") before we entered into the serious issues which were relevant to this study. The first phase included students, while the final phase covered the BoT. This pattern led us to ask increasingly relevant questions at each stage. As a result, leaders were questioned last to address issues which had been raised in previous interview phases.

We interviewed a few people twice to cross-reference. A briefing on the purpose, focus, and privacy of data of this study followed. Each interview lasted 30–40 min, except for the management interviews, which lasted around 1 h. We asked a number of indirect questions. For this study, we asked questions regarding unreported information. This prompted additional useful responses. The interview questions were modified to keep the interactions friendly and to control privacy, and we ended our sessions with a healthy rapport.

Permission was requested to record interviews, which most agreed to, allowing us to record, transcribe, and analyse discussions. To protect responder identities, BoT, management, academics, and students were allocated the codes BT, ML, AC, and SU. These codes were used with digits 1–8 to represent the eight university viewpoints (Table 2). The most common or conflicting descriptions were used to report a group's view. This method was intended to maximise direct responses.

5. Findings and Discussions

Here, the relationship between BoT and management is analysed before examining its impact on university business models. Finally, the factors that influence university business are explained.

5.1. Relationship between Figurehead and Managerial Leadership

The average duration of occupying leadership positions on a BoT, namely as chairman or member secretary, was found to greatly vary according to the type of university. For example, the longest times of the chairman and secretary positions being held were 14.4 and 15.7 years, respectively, at FB universities (Panel A, Figure 2). The briefest duration for individuals to hold these positions were 3.3 and 3.5 years, respectively, as noted at AABP universities (Panel A, Figure 2).

The duration of both positions being held in a particular type of university was virtually the same (Panel A, Figure 2). This may suggest that both BoT leaders might have maintained decent rapport. Length of both chairman and secretary positions was sequentially higher in FB, RG, CH, CaB, NGO, ECO, PC, and AABP universities (Panel A, Figure 2). The longest durations individuals held the VC and treasurer positions were 16.5 and 11.6 years, respectively, at FB universities, while the shortest were 3.6 for both positions at AABP university (Panel B, Figure 2). Sequential durations of the VC and treasurer positions being held also followed virtually the same path as the chairman and secretary positions (Panels A and B, Figure 2). However, the duration of individuals holding the VC and treasurer positions at CH universities did not follow this particular sequence (Panel B, Figure 2).

The durations of both VC and treasurer positions were sequentially higher in FB, RG, CaB, NGO, ECO, CH, PC, and AABP universities. Although the tenure of BoT and management leaders (VC and treasurer) showed a similar duration, the pro-VC position was not balanced (Panel B, Figure 2). The above findings contend that a significant relationship may prevail between "figureheads" and managers, where the tenure of the latter is controlled by their BoT counterparts.

BoT and management leaders highlighted that both a professional relationship and a personal connection between both parties is essential to run a university. BTs 1–8, and MLs 1, 2, 3, 4, and 5 noted that the governance procedures prescribed in PUA-2010 do not allow universities to be run with "honesty" and "loyalty", as the rules do not permit the "owners" to have certain advantages. They added that PUA-2010 did not recognise that the public and private sectors require very different governance mechanisms: the former is ultimately managed by the government exchequer, while the latter must generate its own revenue.

In accordance with the regulations, public university academics are hired as VCs and pro-VCs; such individuals have no experience in understanding or resolving business challenges, as argued by BTs 1–8. MLs 1–8 and BTs 1–8 noted that the VC and treasurer are officially responsible for all financial matters. Financial decisions "must be made" by the VC and the treasurer. Infringement of this rule is an offence. Hence, ML 2 commented:

"Personal relationship between BoT and management is badly needed as academics are too much like novices to run a business. Business is mainly run by the BoT but management holds all the financial controls. Following PUA-2010 guidance, ensuring financial transparency is simply impossible. Therefore, a personal relationship between BoT and management is greatly needed, otherwise both parties would have to go to court, and which is harmful for them and the university".

To avoid such a situation, the BoT must rely on the academics, who are their friends, which is additionally necessary if people on the BoT wish to be the VC or the treasurer. This approach helps to avoid cumbersome situations and conflicts so that smoother operations are possible (BTs 2, 3, 5, and 7 and MLs 1, 5, 6, 7, and 8). The aforementioned scenarios might have led to the sequential nature of the tenures of BoT leaders, VCs, and treasurers. However, BTs 1, 5, 6, 7, and 8 and MLs 1–8 considered that the role of management is rather "ornamental", asserting that such individuals are employed for "PR" reasons—essentially to improve and promote the reputation of the universities while the BoT runs the institution. With this mind, BT 1 commented:

"Being the owners, we run the show and shoulder all responsibilities and risks. Management is just paid to be the best fit ornament. Being a corporate chairman, I am experienced and capable enough to handle CEOs. Management leaders are ornaments and changing these ornaments routinely increases brand value. Some universities may like to keep their ornaments longer as they consider them as best fit. But their BoT in fact runs the show. However, corporate university should follow corporate culture. To oblige UGC rules, we hardly change the VC and pro-VC before completion of their tenure".

The above discussions suggest that the role of management is now more of a "figurehead" one; the BoT has unofficially become the real university management body.

5.2. Dynamic Changes in Figurehead Leadership: Management Crisis

BTs 1, 3, 5, 6, and 8, and MLs 1–8 argued that, while the VC and treasurer have become "figureheads" due to unavoidable circumstances, the pro-VC's role has turned into a "figurehead" rule due to the official regulation, which stated: "university must recruit VC/pro-VC for four years and their tenure can be extended". Inserting an "oblique mark" between VC and pro-VC words, the rules created a further ambiguity—whether recruiting a pro-VC is an optional process.

In this circumstance, retired academics from the public sector are often recruited as "figurehead" VCs to add some lustre to the university. Comparatively younger academics are employed as pro-VCs, who may undertake this role after having taken sabbatical leave. Upon completion of their tenure, these pro-VCs return to their permanent jobs, while "emerita VCs" may further extend their contracts with the support of the BoT. Consequently, the tenures of pro-VCs did not follow the sequences followed by BoT leaders, VCs, and treasurers.

The individuals trusted by a BoT are recruited as management. Pro-VCs' and treasurers' positions often remain vacant, which has created a management crisis. The VC position is often filled as ornamental role to sign off students' degrees. According to Panel A of Figure 3, 29.6%, 55.6%, and 14.8% of universities have full-, partial-, and no-management systems, respectively. Among CaB universities, 90% have full-management systems, while 33.3% of FB universities have no-management systems.

Family members mainly occupy both BoT and management positions in FB universities. Furthermore, 100% of NGO, RG, PC, and CaB universities have VCs (Panel B, Figure 3), while 100% of FB, RG, CaB, and PC universities have treasurers. Only in CaB universities are the Pro-VC positions 100% occupied. According to the verdict of PUA-2010, BoT leaders' role is ceremonial, while management should be performed by the functional leaders. Operational pragmaticism has directed the leadership practice into a different path, which suggests that BoT manages universities, whereby official management has become the "figurehead".

5.3. Leadership and Business Success

Despite BoT's controls for recruiting management roles and converting their responsibilities to have a ceremonial character, CaB, NGO, and CH universities have comparatively better management structures. For example, Panel A of Figure 3 indicates that 90%, 60%, and 50% of CaB, NGO, and CH universities, respectively, have full-time management, while the statistics of their counterparts are disappointing. Here, we discuss the businesses of the various university types. To measure business success, academic–student ratios, student numbers, financial turnover, and campus status were examined. These indicators may not always reflect educational quality. However, they are frequently used to assess private-sector education.

CaB universities have the highest number of students enrolled—8836—followed by FB (7167) and CH (7032) (Panel A, Figure 4). The highest financial turnover and per student costs—USD 19,347,501 and USD 1912, respectively—were found in CaB universities, whereas CH and FB universities stood second and third, respectively (Panels B and C, Figure 4). Other types of university were left behind in this race.

The ratio between academics and students, and the factor of having one's own campus were, respectively, better in CaB, CH, and NGO institutions (Panels A and B, Figure 5). According to the above data, CaB universities have the highest business success, whereas CH universities merely strive to keep up. Some NGO and FB universities have slightly better scores, while others are struggling. Future research should look into how some universities operate with low revenues, student numbers, and tuition fees.

5.4. Factors Influencing Success: Education Philosophy or Business Motive

Three central explanations related to CaB and CH universities' leadership structures emerged—we believe these have guided their business success. Firstly, their leaders have considered university education as a "commercial product" by ignoring what society expects as a product (BTs 1 and 3 and LMs 1 and 3). This deliberation has helped to give campuses a sound strategy for understanding "customers' needs" and attitudes, and to produce a "product" which meets "customers' desires", as argued by BTs 1 and 3. BT 3 added:

"In the name of social product, providing education at a lower price compared to a real production cost would greatly compromise quality. This neither helps students from poorer family backgrounds nor supports business growth but would develop a paper qualification business since we must generate revenue. Investing in a paper qualification is worthless and makes the students disheartened finally".

BTs 4, 5, 6, 7, and 8 emphasised that, as a public good, access to education is a right that benefits society. Therefore, they consider that education should be provided at a reasonable cost. BT 8, ACs 1–8, and SUs 1–8 asserted that this sentiment does not work in education in the modern era of "commodification". The present era has translated education into a "commercial product" without considering what a private good is, let alone what a public good is.

Secondly, as BTs 1, 2, and 3 explained, a viable price is critical for commercial success. Businesses frequently utilise one of two pricing techniques, according to BTs 1, 2, 3, 4, 5, and 8. Identifying production costs is required to produce a profitable product. The selling price should thereafter be fixed as long as it makes a profit. According to BT 3, this is a key success strategy. The second approach proposes the design of a product based on customer affordability (BTs 4, 5, 6, 7, and 8). BT 8 expressed concern over "faulty products" and the quality of education. BTs 1, 4, 5, and 8 proposed that pricing should be aligned with quality assurance, and not exploited by the "high demand of luxury product" or "low price for high demand" theories. BTs 4, 5, 7, and 8 stated that business success comes at the expense of the theories' claims.

Thirdly, investment and job opportunity were major success factors. More money is needed for logistics and to hire qualified personnel. Risks can be taken by CaB and CH universities. These institutions' academics and students are more open to CaB and CH

provisions (BTs 1–8, ACs 1–8, and SUs 1–8). Management, students, and academics are less comfortable with AABP universities. SUs 1–8 noted that, because entrepreneurs are involved with CH and CaB universities, job placement is simpler for their graduates. So, BoT leaders have largely contributed to business success. Before discussing the theoretical and practical consequences of this research, let us make brief note on a proposed paradigm of leadership that may support the improved functioning of the private university sector.

5.5. Diversity in Revenue Collection and Leadership Dynamics: A Way Forward

The question of whether dynamism and diversity in leadership enable an institution to generate new revenue streams, or whether multiple and innovative revenue streams enable an institution to develop a balanced and decentralised ladder of leadership, remains unresolved [1]. Despite widespread criticism, a revenue-generating leadership paradigm has broader implications for university leadership, particularly in private education provision in developing nations [10]. Tuition fees collected from students are the private counterpart's sole source of revenue. This is almost certainly the primary reason for the centralised leadership approach which is prevalent in private university provision in developing nations.

Under the circumstances outlined above, higher education and the degrees conferred by institutions have become "commodities". Furthermore, the leaders of private institutions employ a variety of business methods in order to create cash, perhaps exacerbating the "diploma disease" situation [5]. Additionally, this may inspire leaders of private universities to abandon the higher education ideology. The current revenue-collection process may be one of the most significant impediments to building an effective leadership and management style. As a result, we propose a different revenue-collection strategy (Figure 6) that may aid in the development of a decentralised and dynamic leadership approach. A concise description of the model is included below.

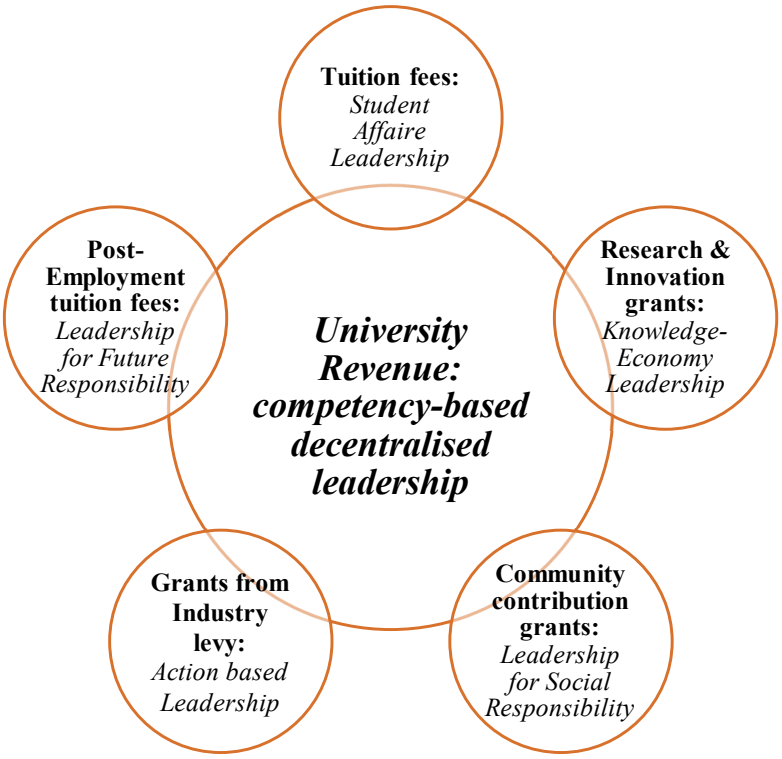


Figure 6. Diversity in university revenue: the dynamics of decentralized leadership.

Higher education is a research-based product that fulfils the demands of industry, business, and the community. Under this scenario, universities should prioritise students as stakeholders, as well as other significant stakeholders, such as industry and the community. To reduce reliance on tuition fees, a variety of revenue-collection mechanisms (such as an industry levy; research and innovation grants; industry and company development grants; and community grants) should be implemented. Tuition fees could generate only a percentage of the revenue. Universities must be competent enough to create graduates who are employable. Following that, an agreement should be reached with employers that allows for impoverished students to pay college fees following employment.

Taking into account a country's national economy, a clear prescription for the minimum and maximum amount of tuition fees that may be collected from an individual for a given programme must be developed. Due to the fact that universities provide skilled labour for industry and business, an industry levy for higher education should be formed by a consortium of industrialists and competent experts. To secure the revenues from the industry levy, inter-university competition should be encouraged. While universities must maintain a reasonable proportion of industry levy revenue, they must also secure proportionate research and community funds. Depending on a single source of revenue should never be permitted. While tuition fees should not be utilised as research grants, universities should seek funding from a variety of sources (such as consultancies, business innovation, research bids).

By assuring the involvement of diverse stakeholders, universities may build a centre of excellence for research, scholarship, and social responsibilities. This would eventually secure the involvement of a variety of competent specialists capable of leading a specialised area in which they have been taught and are competent. The recruitment of such professionals, as well as their remuneration and service regulations, have to be directed by the results accomplished. This will also enable an active role for a variety of stakeholders in collectively administering institutions by ensuring accountability and transparency. Under this scenario, both the "figureheads" and the managerial leaders would be professionally competent and mature, thereby fostering a culture of "competency-based leadership" in higher education [22,27,32].

Although the revenue sources for public- and private-sector universities in developing nations are different in nature, the public sector also receives revenue from a single source—the government exchequer. Due to the government's exclusive reliance on the exchequer, the public sector has developed a political leadership style that constrains universities' ability to be innovative and market-responsive [31,45–47]. Administrators at public institutions frequently misuse funds, as argued by [47,48]. As a result, an updated, revenue-based leadership model tailored to the public sector may likewise help universities in developing nations to operate more successfully. However, with the scope of this project, our leadership model is limited to the private sector.

Without jeopardising educational philosophy, a creative and entrepreneurial leadership style is critical for the university sector of the twenty-first century. As a result, a revenue-based leadership model coupled with a philosophy of higher education may give a balanced, sustainable, and decentralised leadership approach that embodies the "distributed leadership" culture that is prevalent in the universities of developing nations [49]. This may strengthen the connection between the "figurehead" and the managerial executives, enabling the higher education sector to operate in a manner in which research and knowledge serve as economic drivers, rather than as commercial commodities.

6. Implications, Further Research, and Limitations

Here, we explore the theoretical implication of this study and its link to practice; then, the role of the decentralised, competency-based leadership model in sustainable higher education is explained. Finally, further research is proposed, and the limitations of this project are acknowledged.

6.1. Theoretical Implication and Its Practice

The authors of [22,27] stated that a leader's vision matters. A "short-sighted leader" may earn short-term benefits at the expense of the institution's long-term mission and vision [46]. The authors of [27] propose that institutional mission and vision should be connected with governmental policies and the goals of the education sector. The authors of [16] stated that synchronising the missions and visions of institutions, sectors, and countries is essential in measuring leaders' success [32]. Corruption, nepotism, and cronyism thrive under the "anarchy" caused by the derailed visions and goal statements of leaders [32], as the vision and the goal are often set on novelty—not based on reality. Novelty is often further developed by the ongoing perception of society, which keeps changing in different. Therefore, the novelty of the 21st century may not be the same as it was in earlier centuries. Hence, a novelty isolated from the demand of the current era may not necessarily represent the reality. Thus, we need to set a dynamic approach that can set aside various constraints (such as corruption, nepotism, and cronyism) from the education system without denying that the education system experiences those constraints (corruption, nepotism, and cronyism).

Leaders who contribute to "anarchy" by abandoning social interests may succeed [32]. In Bangladesh, the objective of university education is unclear due to the lack of a policy statement. PUA-2010 did not record the goals of private universities, resulting in only the success of businesses. Missions, visions, aims, and objectives are clearly articulated on university websites. Surprisingly, most of the BoT members and management executives were not aware of the contents covered. BoT 1 commented:

"BoT members are neither competent nor qualified enough to outline the university's theoretical missions, visions, aims and objectives. Therefore, we assigned academics to do this for us".

One academic who outlined the missions, visions, aims and objectives for five highly reputable universities commented:

"My US education and professional experiences groomed me well. To outline the missions, visions, aims and objectives and to design course curricula, I browsed reputed US universities' websites".

The above discussions confirm that academic vision and mission statements are not implemented [50]. The authors of [23] suggested that "distributed" leadership may work well if effective collaboration amongst stakeholders exists. A lack of emphasis on the intended education philosophy was evident in our conversations among private university stakeholders. For "distributed" leadership, apparent collaboration is not the same as that proposed in [22,23] or [25].

The widely accepted "distributed" leadership model offers both theoretical and practical connotations for leadership in education, and is fundamentally applicable for K12 provision, especially in publicly financed systems. A well-established decentralised institutional culture and a governance mechanism (both formal and informal) are important prerequisites for the "distributed leadership" model to be functional, as argued by [22,23,27].

Facing reality, the private university sectors in developing nations deny both decentralised organisational culture (at institutional and national levels) and governance mechanisms in order to secure business success. This primarily influences the those universities with a singular dependency on tuition fees to pivot toward the development of higher education as a commodity. Revenue is fundamentally important for an institution to function. Therefore, the intent of this research was to suggest a model that ensures diversity in revenue collection for the private university sector. As suggested by [22,23,27,38], such a model would ultimately lead to the development of a decentralised leadership approach based on the competencies of leaders working at different levels within universities and their controlling agencies (such as the higher education commission, ministry, and directorate).

6.2. Decentralised, Competency-Based Leadership Model: Sustainable Higher Education

Sustainability in education and sustainable education are two different concepts, but the distinction between them is not often acknowledged [47,48,51]. However, the authors of [47] noted that a misleading distinction is also occasionally made to define sustainable education, which may be applicable for sustainability in education [47,48,51]. Here, we clarify this so that this paper does not represent an "acute" view. Sustainability in education refers either to the activities that an educational institute undertakes in order to ensure environmental sustainability or to a study program that includes those agendas—both are capable of protecting against environmental crisis [48]. On the other hand, sustainable education refers to those actions which an institution may initiate to deliver a substantial study program [51]. These actions may include upgrading the program and an institutional developmental schema. In addition to these, substantiable education also refers to the mechanism that is capable of ensuring "financial sustainability" for an educational institution and for the programs offered [51]. Therefore, sustainable education lays beyond the remit of quality control as it also targets the goal and philosophy of education by upholding "financial sustainability" [47,51].

The proposed decentralised, competency-based leadership model is significantly suitable for sustainable higher education, as explained previously. One of the foremost functions of this model is to develop a number of financial sources for generating institutional revenues, which also support the goals and philosophies of higher education. Furthermore, this model proposes an approach for ensuring better use of these funds—collected from the different prominent sources—without compromising the goals, philosophies, and quality of higher education. Hence, the model would both contribute towards education quality and would surely support the development of sustainable higher education—this is applicable in the context of private education provision in emerging nations.

6.3. Further Research and Limitations

This is a small-scale research work; the scale of this study did not allow us to perform a pilot test of the model that we are advocating. Therefore, protracted, longitudinal research, backed up by the sponsorship of government and development partnerships, using a valid, private university leadership model, in the light of the proposed revenue-collection mechanism, is necessary. Extensive research should yield important insights which are not covered here. Such insights would provide micro-level support for the viable operation of private universities and would develop a decent private university sector for developing nations, which would benefit higher education in the eastern part of the globe.

7. Conclusions

While "visionary" leaders foresee the future [22,27], "instructional" and "constructive" leaders often forecast what will happen by analysing the facts, as asserted by the authors of [27,52]. Leaders' farsightedness plays a vital role in the success of any university (such as "instructional" and "distributed") [27]. If a particular country's education system is not guided by a defined philosophy, or if "integrated" aims and objectives are lacking in the education sector, then a "visionary" leader may achieve "business success" at the cost an educational philosophy [32].

Based on these observations, we claim that "visionary" leadership has aided private universities' "business success" at the cost of educational philosophies. Business success is necessary for survival, but this should not come at the expense of education. The mission and vision of higher education institutions are intertwined with national education policies and the sector's goals. Thus, it is critical to align university and government policies with a desired educational philosophy on a national, social, and institutional level. Likewise, other organisations and universities are able to run with various internal and external components that connect both macro and micro units. The fundamental function of management is to coordinate amongst different units so that the university becomes economically productive without compromising the principles of higher education. Hence,

the leaders working within different units should collectively play a well-coordinated function; the role of a leader engaged in a particular unit (at both the macro and micro levels) should be distinct and well-defined.

We conclude that the proposed decentralised, competency-based leadership model—linked with diversified revenue generation—would both ensure an opposite delegation of power and develop an atmosphere of accountability within both micro and macro units, when managed by competent authorities. This model may advance the currently economically productive private university sector without forgoing the principles of higher education in the name of financial sustainability. This proposed decentralised, competency-based leadership model would ensure a very different operational direction for the private university sector, delivering sustainable higher education by mitigating the "financial sustainability crisis". Therefore, the leadership of the private university sector would be distinct from the public counterpart; the private sector needs a specified model, as argued by [53]. The authors of [54] further suggested that the private university sector should look for "efficacy-based leadership" without adhering to a political approach in leadership. The here-proposed leadership model—which will require regular updates to cope with ongoing changes—can serve as a milestone for the requirements of the private sector which were set by [53,54].

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References

1. Morrison, A.J. Developing a global leadership model. *Hum. Resour. Manag.* **2000**, *39*, 117–131. [CrossRef]
2. Bush, T. From Management to Leadership: Semantic or Meaningful Change? *Educ. Manag. Adm. Leadersh.* **2008**, *36*, 271–288. [CrossRef]
3. Rowley, C.; Lee, J.S.K.; Lan, L.L. Why Women Say No to Corporate Boards and What Can Be Done: "Ornamental Directors" in Asia. *J. Manag. Inq.* **2014**, *24*, 205–207. [CrossRef]
4. Chan, D.; Lo, W. Running Universities as Enterprises: University Governance Changes in Hong Kong. *Asia Pac. J. Educ.* **2007**, *27*, 305–322. [CrossRef]
5. Alam, G.M. Quality assurance for private universities in Bangladesh: A quest for specialised institutional governance, management and regulatory mechanism. *Int. J. Comp. Educ. Dev.* **2019**, *22*, 1–15. [CrossRef]
6. Alam, G.M.; Parvin, M.; Roslan, S. Growth of private university business following "oligopoly" and "SME" approaches: An impact on the concept of university and on society. *Soc. Bus. Rev.* **2021**, *16*, 306–327. [CrossRef]
7. Altbach, P. Higher education and the WTO: Globalization run amok. *Int. High. Educ.* **2001**, *23*, 2–4. [CrossRef]
8. Arif, S.; Ilyas, M.; Hameed, A. Student satisfaction and impact of leadership in private universities. *TQM J.* **2013**, *25*, 399–416. [CrossRef]
9. Tan, M.; Hee, T.F.; Piaw, C.Y. A Qualitative Analysis of the Leadership Style of a Vice-Chancellor in a Private University in Malaysia. *Sage Open* **2015**, *5*, 1–11. [CrossRef]
10. Hijazi, S.; Kasim, A.F.; Daud, Y. Leadership Styles and Their Relationship with the Private University Employees' Job Satisfaction in United Arab Emirates. *J. Public Adm. Gov.* **2016**, *6*, 110–124. [CrossRef]
11. Suhana, S.; Udin, U.; Suharnomo, S.; Ud, F.M. Transformational Leadership and Innovative Behavior: The Mediating Role of Knowledge Sharing in Indonesian Private University. *Int. J. High. Educ.* **2019**, *8*, 15–25. [CrossRef]
12. Khalifa, B.; Ayoubi, R.M. Leadership styles at Syrian higher education: What matters for organizational learning at public and private universities? *Int. J. Educ. Manag.* **2015**, *29*, 477–491. [CrossRef]
13. Alam, G.M.; Forhad, A.R.; Ismi, I.A. Can education as an 'International Commodity' be the backbone or cane of a nation in the era of fourth industrial revolution? A comparative study. *Technol. Forecast. Soc. Chang.* **2020**, *159*, 120184. [CrossRef]
14. Al-Shammari, M.; Waleed, R. Entrepreneurial intentions of private university students in the kingdom of Bahrain. *Int. J. Innov. Sci.* **2018**, *10*, 43–57. [CrossRef]
15. Gibson, M.T. Student intimidation, no pay and hunger strikes: The challenges facing Heads of Department in Bangladesh colleges. *J. High. Educ. Policy Manag.* **2020**, *42*, 365–379. [CrossRef]

16. Connolly, M.; James, C.; Fertig, M. The difference between educational management and educational leadership and the importance of educational responsibility. *Educ. Manag. Adm. Leadersh.* **2019**, *47*, 504–511. [CrossRef]
17. Alam, G.M.; Roslan, S.; Al-Amin, A.Q. Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'—Policy Framework to Respond COP21. *Sustainability* **2021**, *13*, 4520. [CrossRef]
18. Crawford, M. Solo and distributed leadership: Definitions and dilemmas. *Educ. Manag. Adm. Leadersh.* **2012**, *40*, 610–620. [CrossRef]
19. Bottery, M. *The Challenges of Educational Leadership*; Paul Chapman: London, UK, 2004.
20. Gunter, H. Labels and labelling in the field of educational leadership. *Discourse-Stud. Cult. Politics Educ.* **2004**, *25*, 21–41. [CrossRef]
21. Woods, P. Authenticity in the bureau-enterprise culture: The struggles for authentic meaning. *Educ. Manag. Adm. Leadersh.* **2007**, *35*, 295–320. [CrossRef]
22. Bush, T.; Glover, D. School leadership models: What do we know? *Sch. Leadersh. Manag.* **2014**, *34*, 553–571. [CrossRef]
23. Bush, T. Moving the school forward: Problems reported by novice and experienced principals during a succession process in Chile. *Int. J. Educ. Dev.* **2018**, *62*, 201–208.
24. Rosser, V.J. A national study on midlevel leaders in higher education: The unsung professionals in the academy. *High. Educ.* **2004**, *48*, 317–337. [CrossRef]
25. Harris, A.; Spillane, J. Distributed leadership through the looking glass. *Manag. Educ.* **2008**, *22*, 31–34. [CrossRef]
26. Van Ameijde, J.D.J.; Nelson, P.C.; Billsberry, J.; Meurs, M.V. Improving leadership in Higher Education institutions: A distributed perspective. *High. Educ.* **2009**, *58*, 763–779. [CrossRef]
27. Bush, T. Leadership and context: Why one-size does not fit all. *Educ. Manag. Adm. Leadersh.* **2017**, *46*, 3–4. [CrossRef]
28. Newman, J.H. *The Idea of University Defined and Illustrated*; Oxford University: London, UK, 1852.
29. May, T.; Perry, B. The role of universities in setting the knowledge economy Agenda. *J. Int. Aff.* **2018**, *72*, 182–184.
30. McKelvey, M.; Buenstorf, G.; Broström, A. The knowledge economy, innovation and the new challenges to universities. *Innovation* **2018**, *20*, 84–86. [CrossRef]
31. Alam, G.M.; Al-Amin, A.Q.; Forhad, M.A.R.; Mubarak, M.S. Does the private university sector exploit sustainable residential life in the name of supporting the fourth industrial revolution? *Technol. Forecast. Soc. Change* **2020**, *159*, 120200. [CrossRef]
32. Franks, J. Institutional ownership and governance. *Oxf. Rev. Econ. Policy* **2020**, *36*, 258–274. [CrossRef]
33. Bryman, A. Effective leadership in higher education: A literature review. *Stud. High. Educ.* **2008**, *32*, 693–710. [CrossRef]
34. Altbach, P.G. Twisted roots: The Western impact on Asian higher education. In *From Dependence to Autonomy*; Altbach, P.G., Selvaratnam, V., Eds.; Springer: Dordrecht, The Netherlands, 1989. [CrossRef]
35. Hazelkorn, E.; Gibson, A. Global science, national research, and the question of university rankings. *Palgrave Commun.* **2017**, *3*, 21. [CrossRef]
36. Hazelkorn, E.; Gibson, A. Public goods and public policy: What is public good, and who and what decides? *High. Educ.* **2019**, *78*, 257–271. [CrossRef]
37. Locke, W.; Bennion, A. The United Kingdom: Academic Retreat or Professional Renewal? In *Changing Governance and Management in Higher Education*; Locke, W., Cummings, W., Fisher, D., Eds.; The Changing Academy—The Changing Academic Profession in International Comparative Perspective; Springer: Dordrecht, The Netherlands, 2011; Volume 2, pp. 175–197. [CrossRef]
38. Locke, W.; Cummings, W.K.; Fisher, D. Comparative Perspectives: Emerging Findings and Further Investigations. In *Changing Governance and Management in Higher Education*; Locke, W., Cummings, W., Fisher, D., Eds.; The Changing Academy—The Changing Academic Profession in International Comparative Perspective; Springer: Dordrecht, The Netherlands, 2011; Volume 2, pp. 369–379. [CrossRef]
39. Hazelkorn, E. *Globalization and the Continuing Influence of Rankings—Positive and Perverse—On Higher Education*; Routledge: London, UK, 2016.
40. Zulfqar, A.; Valcke, M.; Devos, G.; Shahzad, A. Leadership and decision-making practices in public versus private universities in Pakistan. *Asia Pac. Educ. Rev.* **2016**, *17*, 147–159. [CrossRef]
41. McBrayer, J.S.; Jackson, T.; Pannell, S.S. Balance of Instructional and Managerial Tasks as it Relates to School Leaders' Self-Efficacy. *J. Sch. Leadersh.* **2018**, *28*, 596–617. [CrossRef]
42. Bell, J. *Doing Your Research Project*; Open University: London, UK, 2010.
43. George, D.; Mallery, P. *Descriptive Statistics*; Routledge: New York, NY, USA, 2018.
44. Bolster, C.H. Revisiting a Statistical Shortcoming when Fitting the Langmuir Model to Sorption Data. *J. Environ. Qual.* **2008**, *37*, 1986–1992. [CrossRef]
45. Alam, G.M. Three parameters of urban K8 education during pre- and post-COVID 19 restrictions: Comparison of students of slums, tin-sheds, and flats in Bangladesh. *Educ. Urban Soc.* **2022**. [CrossRef]
46. Brady, K.P.; Russo, C.J.; Dieterich, C.A.; Osborne, A.G.; Synder, N.D. *Legal Issues in Special Education: Principles, Policies, and Practices*; Routledge: New York, NY, USA, 2019.
47. Alam, G.M. Does online provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2022**, *66*, 101677. [CrossRef]
48. Sánchez-Carracedo, F.; Moreno-Pino, F.M.; Romero-Portillo, D.; Sureda, B. Education for Sustainable Development in Spanish University Education Degrees. *Sustainability* **2021**, *13*, 1467. [CrossRef]

49. Spillane, J.P. *Distributed Leadership*; Jossey-Bass: New York, NY, USA, 2012.
50. Russo, C.J. *Summary and Recommendations for the Teaching of Religion in Public Schools*; Routledge: New York, NY, USA, 2021.
51. Weisser, C.R. Defining sustainability in higher education: A rhetorical analysis. *Int. J. Sustain. High. Educ.* **2017**, *18*, 1076–1089. [CrossRef]
52. Gunter, H. Distributed Leadership: A Study in Knowledge Production. *Educ. Manag. Adm. Leadersh.* **2013**, *41*, 555–580. [CrossRef]
53. Alam, G.M. Transforming the paradigm of public university leadership into a more political one in emerging nations—A case of Bangladesh. *Int. J. Manag. Educ.* 2022, in press.
54. Alam, G.M.; Asimiran, S.; Ismail, I.A.B.; Ahmad, N.A. The relationship between ornamental and managerial leader in private university sector: Who runs the show and makes a difference? *Int. J. Educ. Reform.* 2022, in press. [CrossRef]

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Pursuing Sustainable Higher Education Admission Policy Reform: Evidence from Stakeholders' Perceptions in China's Pilot Provinces

Jian Li and Eryong Xue *

China Institute of Education Policy, Faculty of Education, Beijing Normal University, Beijing 100875, China
* Correspondence: eryongxue@bnu.edu.cn

Abstract: This study aimed to examine sustainable higher-education admission policy reform and stakeholders' attitudes toward the implementation of a new education policy. We collected 1071 questionnaires exploring stakeholders' attitudes regarding a new higher-education admission policy. We found that administrators at provincial education bureaus, mangers from admission offices at universities and colleges, and teachers at local high schools held relatively positive attitudes toward the education policy of the new college entrance exam, specifically regarding reform directions, enrollment allocations, examination contents and methods, and means of admission. During the process of implementing the new educational policy, despite encountering some critiques regarding the formation and implementation of the new policy, the general reform direction was positively accepted by administrators, mangers, and teachers at different levels. Moreover, attitudes toward the reform direction and the equity evaluation were positively associated with individuals' reform engagement. The implications are discussed to illustrate the rationale and context of the implementation of the new policy in contemporary China.

Keywords: policy reform; reform directions; higher-education policy; China's higher-education assessment

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1. Introduction

Sustainable higher-education admission policy reform is closely related to stakeholders' contextual perceptions of policy implementation. The focus of sustainable higher-education admission policy is the high-quality equity-based development of admission standards, admission processes, and admission outcomes. In China, the National College Entrance Examination (NCEE), which is the standardized admission and unified examination system of national higher-education institutions, plays a significant role in the admission system of Chinese universities and colleges [1]. Along with the goal of building world-class universities and the principles embodied in the current Chinese higher-education system, in 2014, a policy reform aimed at shaping China's NCEE system was jointly released by the Ministry of Education and the State Council, entitled "*Opinions on the Implementation of Deepening the Reform of Examination Enrollment System*" (*2014 Opinions*). Subsequently, this policy reform, entitled "The New College Entrance Examination," designated Zhejiang and Shanghai as the initial two pilot provinces in which to implement a series of educational policies, including shaping reform directions, enrollment allocations, and examination contents and methods of the NCEE [2]. In 2017, students who enrolled in the fall of 2014 in Zhejiang and Shanghai participated in the first new NCEE. The initial implementation of the new NCEE launched smoothly. Four additional pilot provinces and municipalities (i.e., cities under the direct control of the central government), specifically Shandong, Beijing, Tianjin, and Hainan, joined the second round of comprehensive reforms of the new NCEE. In 2018, the Hebei, Liaoning, Guangdong, Jiangsu, Fujian, Anhui, Hunan, Hubei, and Chongqing provinces were added to the third-round list of pilot provinces for the new NCEE [2]. However, during the periodic implementation of policy reform

of the new NCEE, an increasing number of critiques and suggestions have emerged. For example, the balancing of different groups' interests to allocate disparate proportions of enrollments in pilot provinces is a controversial aspect of the policy. Different stakeholders hold a range of attitudes regarding the implementation of China's new NCEE according to their specific roles and interests. For example, most teachers found that the new NCEE imposed a substantial additional burden on their daily teaching workload [3].

Over the past 40 years, since the restoration of the NCEE, continuous improvement has been made to a relatively complete examination and enrollment system, which has made substantial contributions to the growth of students, talent selection by the state, and social equity. A talent selection path with Chinese characteristics that is broadly in line with China's national conditions has been successfully set out [4]. The authority and fairness of this system are generally recognized by society. However, the system involves several problems that are widely acknowledged by the public, such as the "only score theory," which affects students' all-round development, and the "one test for life," which results in an excessive learning burden for some students. As a major political task set by the CPC Central Committee, the new round of reform of the examination and enrollment system includes a major set of changes directly led and promoted by the CPC Central Committee and the State Council. We will proceed with the reform of the examination and enrollment system and explore different operating mechanisms whereby enrollment and examination are separated, students are able to choose multiple examinations, schools recruit students independently in accordance with the law, professional institutions organize and implement examination and enrollment, the government conducts macro-management, and the public takes part in supervision, to fundamentally solve the problems arising from a system in which one test determines the course of a person's life [5]. The comprehensive evaluation and multiple admission mechanisms based on unified college entrance examination and high-school academic level examination results will be gradually implemented in ordinary colleges and universities. We plan to explore ways to reduce the number of subjects in the national unified examination and extend the number of socialized examinations in subjects such as liberal arts, science, and foreign languages to 1 a year. To further implement the requirements of the Third Plenary Session of the 18th CPC Central Committee on promoting the reform of the examination and enrollment system, the State Council issued the Implementation Opinions of the State Council on Deepening the Reform of the Examination and Enrollment System on 4 September 2014. Additional "decisions" and "opinions" on the comprehensive reform of the university entrance exam have led to its comprehensive and systematic deployment, with clear requirements of promoting test enrollment system reform, exploration, and relative separation. Accordingly, students will sit a multiple-choice exam at the school in accordance with the independent recruitment of students, with professional institutions responsible for organizing the implementation, the government responsible for macro management, and the social operation mechanism responsible for supervision, thereby fundamentally solving the shortcomings of "only score theory" and "one test for life" [6]. In 2014, Shanghai and Zhejiang provinces were the first to launch a pilot program for the new Gaokao, indicating that, by 2021, there would be four new Gaokao students in Shanghai and Zhejiang. In 2020, four more provinces, namely Beijing, Tianjin, Shandong, and Hainan, entered the first year of the new Gaokao [7].

Reform engagement refers to whether this policy has been successfully implemented or has met different stakeholders' interests and requirements. In the context of Chinese centralized education, the administrators at provincial education bureaus, managers from admission offices at universities and colleges, and local high-school teachers serve as key stakeholders influencing the implementation of the new NCEE at the provincial, institutional, and local school levels [8]. Ultimately, their differential attitudes toward the new NCEE may result in various degrees of engagement in the new NCEE. A small number of studies on the NCEE have predominantly focused on a given aspect of attitudes toward the new NCEE, such as the equality of enrollment allocation, the social stratification of college access, gender differences in enrollment rates, and students' satisfaction with college

quality embedded in the policy formation and implementation of the NCEE. However, given the multidimensional nature of attitudes toward the new NCEE, a comprehensive understanding of them is not yet clear from various stakeholders' perspectives, along with its relation to stakeholders' reform engagement in the new NCEE [9,10].

To address this critical gap, the current study aimed to examine a comprehensive set of attitudes toward the policy reform of the new NCEE from the perspectives of educational administrators at provincial education bureaus, mangers from admission offices at universities and colleges, and teachers at local high schools. Thus, the research question focuses on the attitudes of these stakeholders toward the policy reform of the new NCEE. The remainder of this paper is organized as follows: Section 1 reviews the literature on China's policy reform related to implementing the new NCEE; Section 2 employs quantitative methods to investigate the four components of attitudes toward the new NCEE; Section 3 provides findings to uncover the barriers and difficulties involved; Section 4 offers conclusions and remarks, with a discussion on the findings related to contextually implementing the policy reform of the new college entrance exam.

2. Literature Review

2.1. A Brief History of the Introduction of the NCEE: Reform Direction

Since 2014, a series of educational reforms with regard to reconstructing and refining the orientation, distribution, content, and approach of the NCEE have been incrementally released and implemented in pilot provinces. Reform direction, enrollment allocation, and examination content and methods were the major components of the new NCEE. To advocate for the general directional principle of "Giving Priority to a Comprehensive Assessment-based Policy and Promoting Equality among Different Regions,", the 2014 Opinion further concentrated on improving the equality of the enrollment allocation to increase the enrollment rate in mid-west regions and large population provinces by continually implementing a series of proposed policies, which are entitled *National Collaborative Plan for Enrollment in Mid-west Regions* and *National Special Plan for Directional Enrollment in Rural and Poverty-stricken Regions*. Both documents involve a series of compensatory policies for rural areas and mid-west regions, which are focused on recruiting students in poverty-stricken areas [11]. In 1977, Chinese universities and colleges enrolled promising students, especially at some key universities, medical colleges, normal colleges, and agricultural colleges. The initial purpose of implementing the bonus policy was to recruit minority students, young people from Hong Kong, Macao, and Taiwan, and returned overseas Chinese students. Since the release of the 2014 Opinion, to eliminate the phenomenon of social corruption, which affected social fairness and justice, strict control of the administration of the bonus policy for college entrance exams was implemented step by step. In 2015, the bonus policy related to sports and art was cancelled. In 2018, the Notice on Enrollment Work in Universities and Colleges was released to abolish the extra bonuses for sports-specialty students, Olympics, science and technology competition winners, excellent provincial students, and students performing outstanding deeds in ideological and political morality. Thus, the incremental abolition of the bonus policy has been considered to be a pivotal policy reform of the new NCEE [12].

2.2. The Enrollment Allocation of the NCEE

The enrollment allocation of the new NCEE was finalized by means of implementing groups of special plans. These special plans were implemented by Chinese governmental agencies, which hierarchically include the national special plan, the local governmental special plan, and the institutional special plan for specific colleges and universities. Specifically, the national special plan aims to recruit more than 10,000 candidates annually from colleges and universities affiliated with the central government in poverty-stricken areas of China to increase the educational opportunities for students in these areas. The special plans for local colleges and universities aimed to construct enrollment plans for senior high schools in remote, poverty-stricken, and ethnic minority areas. These plans were arranged

by central government-affiliated universities or other pilot universities to enroll students independently, with an enrollment plan covering more than 2% of the annual enrollment scale. The exam content and methods offer a specific lens to examine the policy reform of the new NCEE in the pilot provinces. Since 1977, the construction and refinement of exam content and methods has been controversial, including the subject settings, examination contents, and proposition methods of the NCEE. However, two changes have been implemented to gradually revise exam content and methods toward integration [13]. To formulate the basic requirements of comprehensive learning outcomes, China's education policy focuses on speeding up classified examinations with the "major subjects + vocational skills" evaluation model. There are also some major differences in the implementation of pilot schemes in different parts of the country [14].

2.3. The Admission Principles of the NCEE: Exam Content and Methods, and Means of Admission

Under the new college entrance examination system, high school students are required to choose subjects according to the 3 + 1 + 2 model. Students can choose from a total of 12 components. Candidates can choose subjects according to their academic performance, interests, hobbies, and professional tendencies. The new college entrance examination refers to a change in the college entrance examination model, wherein the original liberal arts and science model is referred to as the "3 + 2 + 1" model of college entrance examination subjects. In the "3 + 2 + 1" model, "3" is the national unified college entrance examination subjects of Chinese, mathematics, foreign language, "1" is the preferred subject from the two required subjects (physics and history), and "2" means that two subjects should be chosen for re-selection out of the following four subjects: ideology and politics, geography, chemistry, and biology. All majors at the university require students to take physics or history courses. "Physics only" means that students whose preferred subject is physics can apply for the examination, and the relevant majors are only arranged under the category of physics. "History only" means that candidates whose first choice of subject is history are eligible to apply, and the relevant majors are only eligible for admission under the history category; "Physics or history can be both" means that candidates whose preferred subject is physics or history can register for the examination, and colleges and universities should coordinate related majors in physics and history under the category of the enrollment plan [15].

3. Empirical Studies on the New NCEE Policy

Few studies have examined the history of the Chinese NCEE. The small body of research on the NCEE mainly focuses on equity of college access, which can be largely summarized into the following two major components: rural urban gaps and regional differentiation. The regional imbalanced development in higher education directly causes the differential implementations of the NCEE. Some scholars have argued that the regional differences increase the inequity in college access [16]. It is widely accepted that students in developed regions are more likely to achieve higher educational attainment than their counterparts from underdeveloped areas. In addition, the imbalanced development in China's higher education is reflected in differences in the higher education budgets and funding allocated to support higher education development. The education funding allocation is calculated on the basis of the number of enrollments; thus, some high schools in high-poverty areas and less developed provinces may receive a smaller educational funding allocation because of the relatively low enrollment rate, which may ultimately result in low educational quality. Thus, geographic inequity plays a critical role in the undergraduate admission process. In addition, the learning condition gaps between urban and rural areas have further increased the imbalance in the enrollment allocation of the NCEE. Furthermore, the household registration system is closely related to college admission and enrollment allocation in the NCEE [17]. Compared with other countries, including Western countries and Eastern countries, the higher education entrance examination policy in China is considered to be a particularly important equity issue in different contexts. During the

coronavirus disease 2019 (COVID-19) outbreak, the quality of education recommendations made by the United Nations (UN) through the Sustainable Development Goals (SDGS) of the 2030 Agenda made it necessary to analyze the elements we consider to be essential in the current educational context [18].

4. The Analytic Framework: Integrating Top-Down and Bottom-Up Models

The implementation of the new NCEE policy is considered to be a process of interaction between the setting of goals and the actions designed to achieve them. Specifically, policy implementation involves the connection between policy intention and actual outcomes. As a key process of the policy cycle, policy implementation involves the relationship between the establishment of an apparent intention and the ultimate influences on behavior. Policy implementation focuses on how the setting of policy decisions contributes to putting the policy into effect. In other words, the process of policy implementation involves decisions and activities, which are carried out with the intention of creating, influencing, or controlling the following three dimensions: the constitution of a policy network, the conception of an implementation strategy, and the decisions and activities that are directly addressed by target groups [19].

The analytical framework of the policy implementation vision of the new NCEE integrates "top-down" and "bottom-up" perspectives. In particular, the top-down perspective focuses on the governmental-central policy formation process of policy goals and decisions with political and administrative authorities. Compared with top-down policy implementation, the bottom-up perspective is focused on identifying the main actors involved in public policy, from the street level to the highest level, with the simultaneous consideration of actors. In addition to the real policy implementation of new college entrance exams, a new hybrid model related to analyzing the policy implementation of new college entrance exams is proposed to bridge the gap between top-down and bottom-up models to avoid the conceptual weaknesses of each. Thus, a linkage model between the top-down policy formation related to the policy of new college entrance exams and bottom-up policy implementation involving key relevant administrative stakeholders at various levels was constructed to present an analytical framework of the policy implementation of new college entrance exams. Specifically, this framework is proposed to examine stakeholders' perspectives on the formation and implementation of new policy reform at pilot provinces [20]. In the bottom-up version, stakeholders' attitudes and perceptions regarding the policy reform of new college entrance exams include those of the administrators at provincial education bureaus, mangers from admission offices at universities and colleges, and teachers at local high schools. In the top-down version, the policy reform for NCEE contains the following four major components: reform direction, enrollment allocation, examination content, and methods of NCEE [21].

Along with the proposed analytic framework of the top-down and bottom-up models, the educational policy implementation of the new NCEE is considered as a typical top-down policy formulation and the stakeholders' attitudes toward the new higher education admission policy are regarded as part of a bottom-up model to examine various participants' understandings and reflections on this policy implementation in different contexts. Therefore, the current study integrated top-down and bottom-up perspectives to examine the overall landscape of China's new NCEE.

5. Methods

Participants and Procedures: The present study was approved and monitored by the Institutional Review Board at Beijing Normal University. The sample was obtained from a six-province-wide survey covering the North, South, West, and Central regions of mainland China. A representative sample of administrators at provincial education bureaus, managers from admission offices at universities and colleges, and local high school teachers was obtained. The study was designed to examine attitudes toward the implementation of China's new college entrance exam policy at pilot provinces from various stakeholders'

perspectives. We collected a sample comprising 1071 participants (59.1% female). Most of the participants were of Han ethnicity (914, 98.2%) and the rest were members of minority ethnic groups. Participants' average age was 37.41 years old (standard deviation [*SD*] = 7.15). Except for a small portion of participants with a community college degree (5.5%), most participants (74.5%) had a bachelor's degree. Approximately one third of the participants were from cities (68.8%), approximately one fifth were from small towns (12.9%), and the rest were from villages (8.4%).

Measures: The four dimensions (i.e., reform direction, enrollment allocation, examination contents and methods, and means of admission) of attitudes toward the NCEE were based on the concept of college entrance examination equality indices. Two rounds of surveys and interviews were conducted to collect relevant information about the four dimensions of attitudes toward the NCEE from administrators at provincial education bureaus, managers from admission offices at universities and colleges, and local high school teachers. Finally, 14 items were retained for the final questionnaire. The items were rated on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. This questionnaire was not a standardized instrument with known psychometric properties, and it was constructed on the basis of the research questions in this study. We used Mplus 8.8 software and SPSS.21.0, (Statistical Product Service Solutions), which created by IBM and Stanford University to analyze these data.

Data analytic approach: A confirmatory factor analysis (CFA) was conducted using SPSS.20.0 to examine the construct validity of attitudes toward new college policy reform. We evaluated model adequacy using the following indices (Kline, 2015): the Chi-Square statistic (χ^2), the comparative fit index (CFI; acceptable > 0.90, good > 0.95), the root-mean-square error of approximation (RMSEA; acceptable < 0.08, good < 0.05), and the standardized root-mean-square residual (SRMR; acceptable < 0.08, good < 0.05). In addition, multivariate analyses of variance (MANOVA) were used to examine differences in the dimensions of attitudes toward new college policy reform across gender, age, ethnicity, region, province, education attainment, and workplace.

6. Results

We performed CFAs to examine whether an a priori factor structure fit the data (i.e., the construct validity). Four of the five factors were latent constructs (i.e., reform directions, enrollment allocations, test contents and methods, and means of admission). A total of 15 items were used to assess the four latent constructs and the manifest constructs (i.e., equality evaluation). Cronbach's α values were calculated to assess the reliability of the subscales. The following fit indices for the five-factor model were acceptable: χ^2 (71) = 411.63, $p < 0.001$, CFI = 0.91, RMSEA = 0.07 (90% CI, 0.066, 0.079), SRMR = 0.0. Factor loadings ranged from 0.68 to 0.74 for reform directions, 0.78 to 0.79 for enrollment allocations, from 0.61 to 0.73 for test contents and methods, and 0.51 to 0.74 for means of admission. Cronbach's α coefficients for the four first-order factors were acceptable and were around 0.76.

To examine the differences in attitudes toward new college policy reform as a function of gender, age, ethnicity, region, province, education attainment, and workplace, we conducted seven-way MANOVAs for the five first-order constructs. Female participants expressed greater approval of enrollment allocation (mean [*M*] = 1.61, *SD* = 0.75 for males; *M* = 1.79, *SD* = 0.85 for females) compared with male participants. There were no differences in approval by ethnicity (i.e., Han and ethnic minorities) or region (i.e., cities, towns, and rural areas) for all five constructs. Regarding differences across age groups, participants over 60 years old generally reported greater approval of reform directions (*M* = 3.78, *SD* = 0.53 for participants over 60 years old, *M* = 2.21, *SD* = 0.07 for 41–50-year-old participants, *M* = 2.04, *SD* = 0.06 for 31–40-year-old participants, *M* = 2.01, *SD* = 0.11 for 26–30-year-old participants, *M* = 2.35, *SD* = 0.21 for 18–25-year-old participants), enrollment allocations (*M* = 3.33, *SD* = 0.45 for participants over 60 years old, *M* = 1.18, *SD* = 0.06 for 41–50-year-old participants, *M* = 1.67, *SD* = 0.05 for 31–40-year-old participants, *M* = 1.66, *SD* = 0.10

for 26–30-year-old participants, $M = 1.71$, $SD = 0.18$ for 18–25-year-old participants), examination contents and methods ($M = 3.50$, $SD = 0.45$ for participants over 60 years old, $M = 2.07$, $SD = 0.06$ for 41–50-year-old participants, $M = 1.94$, $SD = 0.05$ for 31–40-year-old participants, $M = 1.98$, $SD = 0.10$ for 26–30-year-old participants, $M = 2.01$, $SD = 0.18$ for 18–25-year-old participants), means of admission ($M = 3.33$, $SD = 0.33$ for participants over 60 years old, $M = 1.59$, $SD = 0.05$ for 41–50-year-old participants, $M = 1.52$, $SD = 0.04$ for 31–40-year-old participants, $M = 1.56$, $SD = 0.07$ for 26–30-year-old participants, $M = 1.53$, $SD = 0.13$ for 18–25-year-old participants), and equity evaluation ($M = 3.67$, $SD = 0.55$ for participants over 60 years old, $M = 2.10$, $SD = 0.08$ for 41–50-year-old participants, $M = 1.86$, $SD = 0.07$ for 31–40-year-old participants, $M = 1.80$, $SD = 0.12$ for 26–30-year-old participants, $M = 2.00$, $SD = 0.22$ for 18–25-year-old participants). However, there were no significant differences between either of the two age groups below 60 years of age on any of the five first-order constructs.

Regarding differences across provinces, participants from Zhejiang Province expressed greater approval of the reform directions than those from Shanghai and Shandong ($M = 2.32$, $SD = 0.80$ for Zhejiang, $M = 1.98$, $SD = 0.81$ for Shanghai, and $M = 2.02$, $SD = 0.98$ for Shandong). However, there was no significant difference between any pair of provinces (Beijing, Shanghai, and Shandong). Participants from Zhejiang Province and Shanghai Province expressed greater approval of exam content and methods compared with participants from Shandong or Beijing ($M = 2.30$, $SD = 0.77$ for Zhejiang, $M = 2.13$, $SD = 0.78$ for Shanghai, $M = 1.83$, $SD = 0.75$ for Shandong, $M = 1.90$, $SD = 0.75$ for Beijing). Regarding equity evaluation, participants from Zhejiang and Beijing reported more agreement than those from Shanghai and Shandong ($M = 2.23$, $SD = 1.03$ for Zhejiang, $M = 1.72$, $SD = 0.90$ for Shanghai, $M = 1.80$, $SD = 0.88$ for Shandong, $M = 2.13$, $SD = 1.01$ for Beijing). Moreover, participants with high-school degrees only expressed more approval of reform directions ($M = 3.56$, $SD = 1.71$ for those with high-school degrees only, $M = 2.11$, $SD = 1.23$ for those with specialist qualifications) and equity ($M = 3.00$, $SD = 1.73$ for those with high-school degrees only, $M = 1.33$, $SD = 0.49$ for those with specialist qualifications) compared with those with specialist qualifications. Participants with high-school degrees ($M = 2.47$, $SD = 2.20$) only expressed greater approval regarding the means of admission than participants with college degrees ($M = 1.55$, $SD = 0.58$). In addition, participants who worked in middle schools ($M = 2.08$, $SD = 0.80$) reported greater approval of exam content and methods compared with those who worked at universities ($M = 1.62$, $SD = 0.82$) (See Figure 1).

Moreover, we examined reform direction, enrollment allocation, exam content and methods, means of admission, and equity evaluation in relation to reform engagement. Age, gender, province, workplace, household registration, and education attainment were controlled as covariates. Although a non-significant chi-square result would be preferable, the chi-square test revealed a significant result because of the large sample size of χ^2 $(161, N = 1071) = 562.59$, $p < 0.001$. On the basis of the criteria suggested by Little (2013), the following model fits were acceptable: CFI = 0.90, RMSEA = 0.052 (90% confidence interval [CI], 0.047, 0.056), SRMR = 0.04. Reform direction ($\beta = 0.29$, $p < 0.001$) and equity evaluation ($\beta = 0.15$, $p < 0.01$) were positively associated with reform engagement. Enrollment allocation, exam content and methods, and means of admission were not associated with reform engagement (see Figure 2).

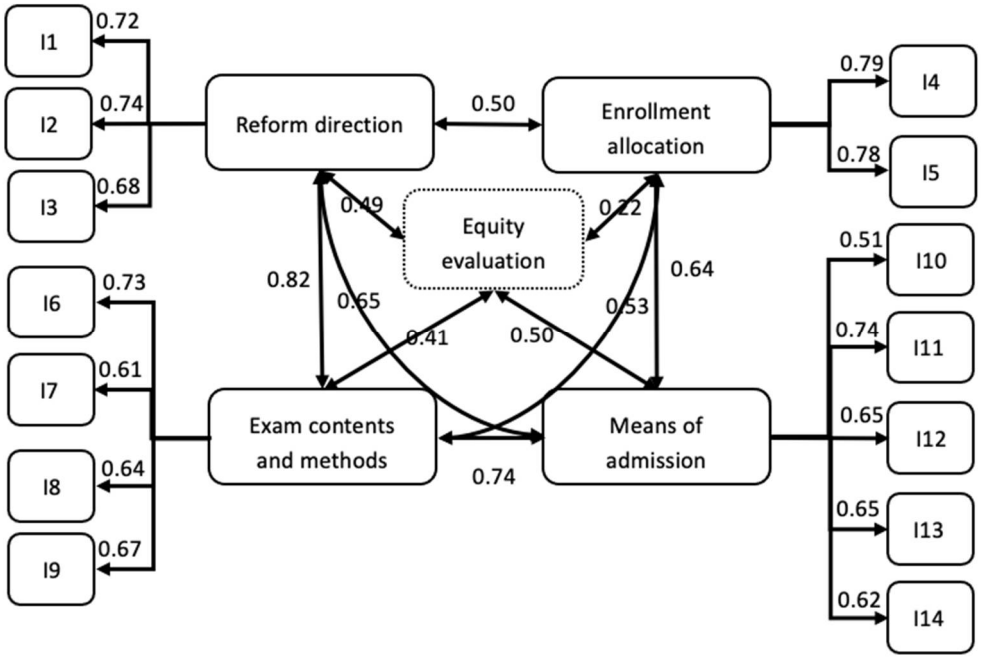

Figure 1. The five-factor model of attitudes toward new college policy reform. All of the factor loadings and correlations were significant at $p < 0.001$.

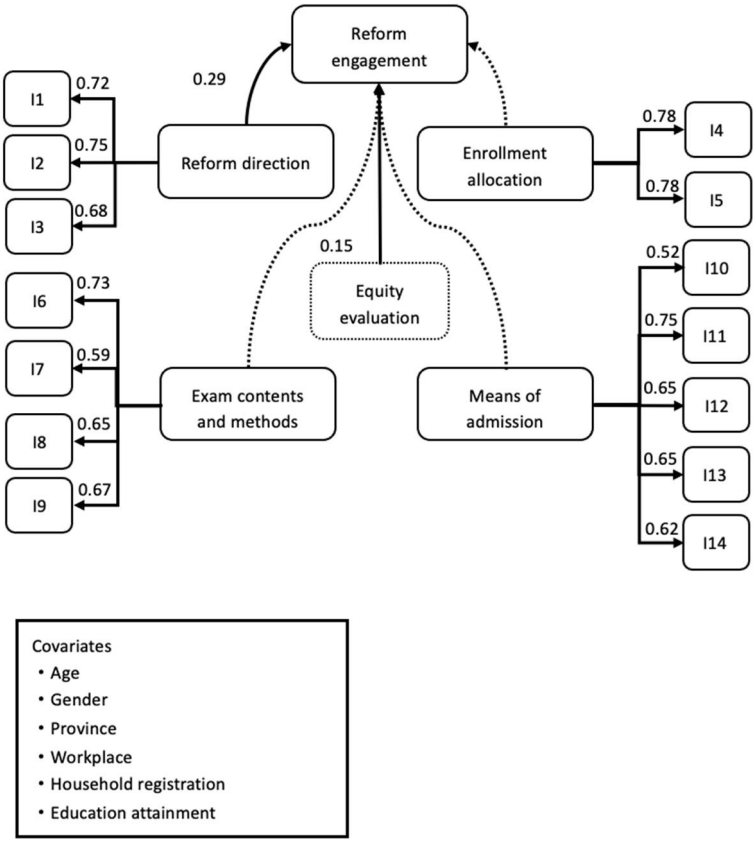

Figure 2. Structural equation model testing the relationships between five first-order factors and reform engagement.

7. Discussion

7.1. The Key Findings of Stakeholders' Attitudes toward Policy Reform

Significant differences were found in stakeholders' attitudes toward the policy reform of NCEE based on gender, age, ethnicity, region, province, education attainment, and workplace. Female teachers, mangers, and administrators expressed more positive attitudes toward the implementation of the policy of enrollment allocation compared with their male counterparts. However, there were no statistically significant differences in approval by ethnicity (Han versus ethnic minorities) or region (cities and towns, versus rural areas) in terms of creating and implementing the new NCEE. Interestingly, regarding significant differences across age groups, participants that were over 60 years old generally expressed more positive attitudes regarding the reform directions of the new NCEE compared with their counterparts from other age groups. Older participants tend to have more insightful and objective individual learning experiences and judgments regarding the policy transformation of Chinese college entrance examinations compared with their younger counterparts. Broadly speaking, the results appeared to demonstrate that older/senior participants, who had a sophisticated understanding of the issue, generally expressed prudent attitudes regarding the reform directions of college entrance exams, suggesting that the general directions and orientation of policy reform are consistent with the contemporary trends of Chinese college entrance exams [22,23].

7.2. Analyses of Various Participants

Older participants who have witnessed the historical trends of policy reform might feel that the general direction of policy reform is fundamentally consistent with the historical direction of reforms. Specifically, in 1977, the NCEE aimed to give priority to key universities and colleges to select promising candidates. In 1984, Opinions on Reforming the Enrollment Source Plan of Institutions of Higher Education (1984 Opinion) was released by the Chinese Ministry of Education, which outlined a general direction of selective admission, allocating 30%–35% of the annual enrollment plan to high-quality candidates. To further narrow the enrollment gap between rural and urban areas, in 2006, the Ministry of Education released a new admission direction, entitled "Promoting Equality among Different Regions" [24,25]. Since then, the general admission direction of the NCEE has consistently tended to provide an increased proportion of the admission quota to candidates from developing provinces, regions, and/or rural areas, and poor counties. Since the release of the 2014 Opinion, two programs have been implemented to increase the admission quota of students from rural and developing locations [26]. For example, the Collaborative Plan for Enrollment in the Central and Western Regions suggests enrolling students from both mid-west regions and rural and poverty-stricken areas. Thus, the transformation of reform direction from efficiency-driven to equity-driven values embodies the policy of incremental change regarding reconstructing and reshaping the development of China's NCEE. Moreover, participants from Zhejiang Province reported more positive attitudes toward the reform directions of the new NCEE compared with their counterparts from Shanghai and Shandong. As one of the most developed provinces, the overall higher education system of Zhejiang Province developed more rapidly compared with the systems of other provinces in terms of enrollment rates and graduation rates. Historically, people in Zhejiang Province have held more positive and active perceptions of implementing new educational policies, which are related to faculty development, higher education financial allocation, and talent cultivation since the reform and opening policy [27,28]. In addition, in terms of the interpretation of age, region, gender or ethnicity, we found that different regional allocation, gender distribution, and ethnicity have clearly impacted attitudes toward educational policy implementation. For example, participants in highly developed regions tend to hold positive attitudes toward the development of higher education admission policy and participants from low-developing regions, such as rural areas, tend to hold negative or critical perspectives on the implementation of new admission policy, depending on the context.

7.3. The Regional Contextual Analysis of Selected Provinces

Comprehensive scores are composed of scores on the unified college entrance examination, senior high school entrance examinations, and the comprehensive quality evaluation [29,30]. This approach applies specialty enrollment plans by which colleges are required to assess students' abilities through unified examinations, and general high school academic proficiency examinations and interviews (or skills tests). Comprehensive quality evaluation is performed by observing, recording, and analyzing students' overall development, including their ideological and moral character, academic level, physical and mental health, artistic accomplishments, and social practice. Additionally, this evaluation approach considers students' social responsibility, innovative spirit, and practical ability. Comprehensive assessment scores include the content, standards, forms, and methods of assessment in colleges and universities, which are determined by the pilot universities according to their training objectives and the requirements of their disciplines and specialties, reflecting the assessment of their professional qualities and potential [31]. Thus, economic development plays an inevitable role in influencing perceptions of the equity evaluation of the new NCEE [32]. It is worth noting that participants who are administrators with high-level degrees more frequently expressed support for the reform directions of the new NCEE than their counterparts with specialist qualifications. Participants with high-level degrees also held more positive attitudes toward admission approaches and exam content than mangers at the admission offices in universities and colleges. In this sense, since the release of the 2014 Opinion, administrators at provincial education bureaus may have reached widespread agreement regarding the accessibility and feasibility of implementing the policy of the new NCEE, especially regarding the admission approach and exam content [33–37]. The structural equation modeling results suggest that the reform direction, enrollment allocation, exam content and methods, means of admission, and equity evaluation all contribute to predicting the key stakeholders' perspectives and attitudes, supporting the rationale of the proposed conceptual framework described previously [38].

7.4. The Limitations and Future Study

However, the current study has several limitations. First, a larger sample size would be helpful in future studies to improve the robustness of statistical analyses. Second, conducting more interviews might offer a clearer contextual background to explain stakeholders' attitudes and engagement in implementing higher education admission policy. Third, more case studies should be obtained to analyze the enrollment allocation, exam contents and methods, and the means of admission, which failed to predict the reform engagement. This finding indicates the prevalence of critiques and disagreements regarding how to construct and implement specific educational policies [39,40]. In future studies, larger samples of respondents from specific provinces may be useful for exploring various stakeholders' perspectives on higher education admission policy development contextually.

Debates regarding sustainable higher education and sustainability in higher education typically have two dimensions [41,42]. While the first dimension expresses discourse that supports the development of a robust higher education system to deliver timely higher education, the second describes the complexity of environmental factors and their incorporation in higher education [43]. Specifically, higher-education institutional sustainable development is considered to be a critical concept to promote global sustainable education development. The development of sustainable higher education includes multiple aspects, including economic, ecological, and social factors and dimensions. In addition, from a technological perspective, creating sustainable higher education is also closely associated with the promotion and distribution of quality education through technological innovation and advances. For example, Alam (2022) argue that "COVID-19 appears to have been utilized by the HE system as an excuse to exacerbate the "diploma disease crisis," a scenario that must be resolved by developing a proper policy framework that allows HE to play the necessary role in an emergency" [44–46]. Therefore, achieving sustainable higher education and sustainability in higher education requires complicated and multi-dimensional factors

to be embraced, so as to continuously shape a more inclusive and efficient global higher educational system.

8. Conclusions

The results of the current study revealed that administrators at provincial education bureaus, mangers from admission office at universities and colleges, and teachers at local high schools hold relatively positive attitudes toward the education policy of the new college entrance exam, specifically regarding reform directions, enrollment allocations, examination content, and the methods and means of admission. During the process of implementing the educational policy of the new NCEE, although the policy received some critique regarding the formation and the implementation of the NCEE, the general reform direction was widely approved of by administrators, mangers, and teachers at different levels. In future studies of this topic, regional differences and differences related to socioeconomic status should be investigated in further depth. Meanwhile, the shift to online admission processes and examinations during the COVID-19 pandemic may necessitate a new direction for future policy design and policy formation regarding advancing the quality of the higher education admission process. Thus, promoting various basic digital competencies for students is considered to be an important part of an appropriate action plan.

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References

1. Wang, J. Chinese parental academic socialization prior to college entrance examination: Insights from urban and rural areas. *J. Fam. Stud.* **2021**, 1–18. [CrossRef]
2. Zhong, X.; Wang, W. Consistency of Zhejiang Provincial College Entrance Examination Questions and Curriculum Standards Based on Knowledge Map Construction. *Math. Probl. Eng.* **2022**, *2022*, 3959688. [CrossRef]
3. Dang, G.; Guo, Y. A Creative Design Framework for Math Exam Questions Concerning Inequalities and Zeros of Functions with an Unknown Parameter in China National College Entrance Examination. *Mathematics* **2022**, *10*, 1618. [CrossRef]
4. Wang, X. China national college entrance examination brings new changes to high schools. *J. Contemp. Educ. Res.* **2021**, *5*, 11–17. [CrossRef]
5. Zuo, J. Three dimensional structure of college entrance examination function and its new era turn. *Front. Educ. Res.* **2022**, *5*, 11–18.
6. Chen, B. On the complexity of Immigration College Entrance Examination Policy: A Content Analysis Based on Plans of 30 Provinces. *Educ. Sci.* **2015**, *31*, 223–234.
7. Chen, J.; Ding, Y.; Ye, X. Cause and effects of school choice of the students of senior high school in China. *Educ. Res. Mon.* **2014**, *5*, 36–45.
8. Chen, F.; Ye, Z. A new reform of the college entrance examination: To create an environment for improving student comprehensive development. *Mod. Teach.* **2015**, *31*, 5–8.
9. Davey, G.; De Lian, C.; Higgins, L. The university entrance examination system in China. *J. Furth. High. Educ.* **2007**, *31*, 385–396. [CrossRef]
10. Duan, J. College entrance examination reform: Change the symptoms not the disease. *J. Hubei Univ. Educ.* **2010**, *27*, 107–109.
11. Elmore, R.F. Forward and backward mapping: Reversible logic in the analysis of public policy. In *Policy Implementation in Federal and Unitary Systems*; Hanf, K., Toonen, T.A.J., Eds.; Martinus Nijhoff Publishers: Dordrecht, The Netherlands, 1985; pp. 33–70.

12. Feng, Y. National college entrance examinations: The dynamics of political centralism in China's elite education. *J. Educ.* **1999**, *181*, 39–57. [CrossRef]
13. Jiang, C. Theory on abolition of the College Entrance Examination: A beautiful mandala. *High. Educ. Res. Eval.* **2007**, *2*, 62–64.
14. Jiang, G. Adhere to strengthening moral education and cultivating people as the core, and to deepen the reform of the content of the College Entrance Examination. *China High. Educ.* **2015**, *51*, 31–34.
15. Jacob, W.J.; Mok, K.H.; Cheng, S.Y.; Xiong, W. Changes in Chinese higher education: Financial trends in China, Hong Kong and Taiwan. *Int. J. Educ. Dev.* **2018**, *58*, 64–85. [CrossRef]
16. Zong, X.; Zhang, W. Establishing world-class universities in China: Deploying a quasi-experimental design to evaluate the net effects of Project 985. *Stud. High. Educ.* **2019**, *44*, 417–431. [CrossRef]
17. Kline, R.B. *Principles and Practice of Structural Equation Modeling*, 3rd ed.; Guilford: New York, NY, USA, 2015.
18. Otero, J.M.; Ortega, J.H. Los objetivos de desarrollo sostenible. *Aportes Desde La Investig. Educ. Comprometida* **2020**, *24*, 149–173. [CrossRef]
19. Li, Q. The revolution of teaching and learning under new curriculum: My thoughts on understanding Hengshui High School educational revolution. *Chin. Sci. Technol. Econ. News Database* **2016**, *4*, 7.
20. Li, S. The Preparation of National College Entrance Examination (NCEE) in China. In Proceedings of the Comparative and International Education Society (CIES) Annual Meeting, Beijing, China, 25 April–2 May 2021.
21. Liu, A.; Xie, Y. Influences of monetary and non-monetary family resources on children's development in verbal ability in China. *Res. Soc. Stratif. Mobil.* **2015**, *40*, 59–70. [CrossRef]
22. Liu, L. An Overview of Development of Higher Education Access in China. *High. Educ. Stud.* **2012**, *2*, 107–113. [CrossRef]
23. Liu, Z. Institution and inequality: The hukou system in China. *J. Comp. Econ.* **2005**, *33*, 133–157. [CrossRef]
24. Muthén, L.K.; Muthén, B.O. *Mplus User's Guide*, 7th ed.; Springer: Los Angeles, CA, USA, 1998–2015.
25. Mok, K.H.; Lo, Y.W. The impacts of neo-liberalism on China's higher education. *J. Crit. Educ. Policy Stud.* **2007**, *5*, 316–348.
26. OCED. Education at a Glance 2008. Available online: https://www.oecd.org/education/skills-beyond-school/41284038.pdf (accessed on 2 June 2020).
27. O'Toole, L.J. Rational Choice and Policy Implementation: Implications for Interorganizational Network Management. *Am. Rev. Public Adm.* **1995**, *25*, 43–57. [CrossRef]
28. Paudel, N. A Critical Account of Policy Implementation Theories: Status and Reconsideration. *Nepal. J. Public Policy Gov.* **2009**, *25*, 36–54.
29. Pulzl, H.; Treib, O. Implementing public policy. In *Handbook of Public Policy Analysis: Theory, Politics and Methods*; Frank, F., Miler, G.J., Sidney, M.S., Eds.; Routledge: London, UK, 2006.
30. Ross, H.; Wang, Y. Reforms to the College Entrance Examination in China: Key Issues, Developments, and Dilemmas. *Chin. Educ. Soc.* **2010**, *46*, 3–9. [CrossRef]
31. Wang, Y. Study on the Setting up of College Entrance Examination of Physical Education Specialty in Jiangxi Province. Ph.D. Thesis, Soochow University, Suzhou, China, 2013; pp. 5–8.
32. Xu, J.; Yi, X. Can the Increase in Public Expenditure on Education Alleviate the Second-Generation Phenomenon? An Analysis of Intergenerational Income Mobility Based on CHNS. *J. Financ. Econ.* **2014**, *40*, 17–28.
33. Zhang, Y. History and Future of the National College Entrance Exam (NCEE) in China. In *National College Entrance Exam in China*; Springer: Singapore, 2016; pp. 1–15.
34. Zhang, H.; Wang, X. Equity Issues in China's College Entrance Examination Policy. In *Equality in Education*; Sense Publishers B.V.: Rotterdam, The Netherlands, 2014; pp. 79–93.
35. Zhang, Y.; Chen, D.S.; Wang, W. The heterogeneous effects of ability grouping on national college entrance exam performance–evidence from a large city in China. *Int. J. Educ. Dev.* **2014**, *39*, 80–91.
36. Zhang, Y.; Zhou, X. Can Higher Household Education Expenditure Improve the National College Entrance Exam Performance? Empirical Evidence from Jinan, China. *Curr. Issues Comp. Educ.* **2017**, *19*, 8–32.
37. Zheng, R.; Wan, Y. The problem of unified College Entrance Examination and evaluation of its causes. *J. Cent. China Norm. Univ.* **2015**, *54*, 154–160.
38. Zhou, B. Discussion about the lack and promotion of educational function in the College Entrance Examination system. *Theory Pract. Educ.* **2009**, *29*, 17–21.
39. Zhu, Y. The division system of liberal arts and science, the cancer in Chinese education. *Educ. Sci. Res.* **2004**, *15*, 61.
40. Zivin, J.G.; Song, Y.; Tang, Q.; Zhang, P. Temperature and high-stakes cognitive performance: Evidence from the national college entrance examination in china. *J. Environ. Econ. Manag.* **2020**, *104*, 102365. [CrossRef]
41. Günther, J.; Overbeck, A.K.; Muster, S.; Tempel, B.J.; Schaal, S.; Schaal, S.; Kühner, E.; Otto, S. Outcome indicator development: Defining education for sustainable development outcomes for the individual level and connecting them to the SDGs. *Glob. Environ. Change* **2022**, *74*, 102526. [CrossRef]
42. Celikdemir, D.Z.; Gunay, G.; Katrinli, A.; Alpbaz, S.P. Defining sustainable universities following public opinion formation process. *Int. J. Sustain. High. Educ.* **2017**, *18*, 294–306. [CrossRef]
43. Daniela, L.; Gutiérrez-Braojos, C.; Lytras, M.D.; Visvizi, A. Sustainable Higher Education and Technology-Enhanced Learning (TEL). *Sustainability* **2018**, *10*, 3883. [CrossRef]

44. Alam, G.M.; Forhad MA, R. Sustainable achievement of selective KPIs of different players in education: An update for policy discourse and role of tertiary education. *Int. J. Learn. Chang.* **2021**, *14*, 137–158. [CrossRef]
45. Alam, G.M. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef] [PubMed]
46. Alam, G.M.; Roslan, S.; Al-Amin, A.Q.; Leal Filho, W. Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'-Policy Framework to Respond COP21. *Sustainability* **2021**, *13*, 4520. [CrossRef]

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Article

The Mediating Effect of Perceived Institutional Support on Inclusive Leadership and Academic Loyalty in Higher Education

Olabode Gbobaniyi [1,*], Shalini Srivastava [2], Abiodun Kolawole Oyetunji [3,4,5], Chiemela Victor Amaechi [3,6,7,*], Salmia Binti Beddu [7] and Bajpai Ankita [8]

[1] Department of Business Management, Global Banking School, M. Mangion, West Block Level 5/6 San Ġiljan, 3180 Saint Julian's, Malta
[2] Department of Business Management, Global Banking School, Devonshire Street North, Manchester M12 6JH, UK; ssrivastava@globalbanking.ac.uk
[3] Department of Construction Management, Global Banking School, Devonshire Street North, Manchester M12 6JH, UK; abiodunoyetunji@gmail.com
[4] Lancaster Environment Centre (LEC), Lancaster University, Lancaster LA1 4YQ, UK
[5] Department of Estate Management, University of Benin, Benin City 300287, Nigeria
[6] School of Engineering, Lancaster University, Bailrigg, Lancaster LA1 4YR, UK
[7] Institute of Energy Infrastructure, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang 43000, Selangor, Malaysia; salmia@uniten.edu.my
[8] Department of International Relations, SRM University, Amaravati 522502, India; ankita.b@srmap.edu.in
* Correspondence: ogbobaniyi@globalbanking.ac.uk (O.G.); chiemelavic@gmail.com (C.V.A.)

Abstract: Globally, people have a rising desire to obtain certificates, degrees, and diplomas in higher institutions, described as "diploma disease". Additionally, the need for sustainable education becomes imperative as globalization increases. To meet these demands, there is a need for Higher Education Institutions (HEIs) to have adequate support for both students and academics. However, these HEIs are faced with the challenge of meeting set goals and values. For leaders in HEIs, inclusion is a critical challenge. This paper investigates perceived institutional support's (PIS) role in mediating the co-relationship between academic loyalty and inclusive leadership within HEIs. The study presents a literature review to give some background. This paper's conceptual framework is built on PIS from social exchange theories. Based on the design, a quantitative survey was adopted for the study. A random sample of 402 academics in HEIs was deployed for the study. A questionnaire instrument was designed to elicit information from the respondents. A structural equation model (SEM) was then adopted for the data analysis. The SEM approach was utilized to investigate the connection between academic loyalty and inclusive leadership at HEIs, with the mediating factor of PIS. The findings reveal a positive relationship exists between academic loyalty and inclusive leadership. While PIS positively connects both, there is also an inference that institutional support exists. This study provides insights that could assist stakeholders in formulating policies on employee needs and what could be done to improve and attain sustainable education in HEIs. It highlights applicable impacts towards increased productivity in HEIs, reflecting achieved targets regarding key performance indicators (KPI) and improved institutional performance.

Keywords: academic loyalty; higher education institution; inclusive leadership; institutional performance; key performance indicator (KPI); leadership; perceived institutional support; policy; structural equation modelling; sustainable higher education; teacher support

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1. Introduction

The need to attain sustainable education becomes imperative as globalization increases. This trend has also been an attempt to meet education goals set by the United Nations Sustainable Development Goals (SDG) [1–3]. More so, there is a rising desire to obtain certificates, degrees, and diplomas from higher institutions. This attitude leads to a situation

termed the "diploma disease", as described by Alam [4]. Whether the rising aspirations and demand to acquire these certificates could bring about sustainable education is still debatable [4]. Despite this, it is believed that Higher Education Institutions (HEIs) have been confronted with increasing difficulties in upholding their values, meeting set goals, and achieving their objectives [4–6]. These challenges could be due to the increasing volatility of the global financial environment, multiculturalism, internationalization, migration, employment demands, rise in international competition, and privatization [7,8]. Kezar and Holcombe [9] also identified the factors that influence the drive into HEIs, including partnerships, greater accountability pressure, new technologies, an increase in prospective students, cross-border academic mobility, the need for shifting demographics, and new business models. With these challenges, HEIs need a new form of leadership to propel their institution's vision, mission, and purpose towards ensuring they adhere to their values and can achieve their goals and standards.

One metric that is used by the leadership of various institutions includes defining key performance indicators (KPI) which help in measuring the employees' performance as well as the institutional performance. It defines various targets, measurable tasks, and timelines for the indicators. To ensure inclusivity, there are usually discussions conducted between the leadership and the employees; thus, KPIs can enable inclusive leadership. Leadership has remained an important factor influencing value, standards, productivity, and performance in HEIs [10]. However, the review of leadership studies in higher education (HE) reveals that most of the discourse on leadership is not only interpreted by academics in different forms, but its approach in the sector has predominantly been a top-down approach [11,12]. Unfortunately, this top-down leadership approach is counterproductive and misaligned with the myriad of current issues facing today's HEI, as leaders in the sector seemingly forget they are to provide both managerial and intellectual leadership. Alam [12], based on a case study in Malaysia, discussed the leadership models in privately run HEIs. They were considered enterprise-style leadership because they are highly centralized, making them unsustainable in an HE environment. The increasing focus on leadership in HEIs to achieve sustainable higher education has escalated the need to investigate how leadership styles in HEIs affect the academics in their institutions [13,14].

Different leadership models could be formed in educational settings, mainly where a managerial approach exists [12,15]. As a result, there is a need to ensure that educational leadership is not just encouraged but also sustainable. To promote this, managerial leadership should be involved in running the affairs of education and developing policies that can help manage the challenges that may face sustainable education [12,15]. One example of managerial leadership required to attain global educational best practices is loyalty and support toward academic institutions, students, and staff [16]. The greater focus of leaders in HEIs has been on providing managerial leadership, with little emphasis on the intellectual aspect. This helps stakeholders develop greater abilities to acquire knowledge and evolve in complicated environments. This also enables these stakeholders to learn more about the HEIs and adapt to the practices unique to their institutions. Thus, it breeds a more approachable set of stakeholders that could also provide necessary institutional support to the employees, which also requires a deeper understanding of the organizational culture of the HEI.

Organizational behavior studies have argued that intellectual leadership further creates inclusiveness and inclusive leadership, and relevant stakeholders can innovate and change flexibly by using quality management processes [17,18]. With intellectual leadership, the leader, through their position, delegates authority to make changes and, through inclusiveness, create a culture that supports the cross-functional sharing of ideas that build institutional memory and create co-ownership of institutional and departmental goals and strategies [19]. As a result, if leaders in HEIs adhere to their responsibility of providing both managerial and intellectual leadership by promoting inclusiveness and adopting it into their leadership style, institutions will have an increased tendency to surmount some of their challenges when academics are highly satisfied and loyal. According to Elegido [20],

an employee's loyalty is defined as their conscious commitment to serve the greater good of the organizational structure, regardless of whether doing so may involve sacrificing some component of their self-interest apart from what would be needed by their corporate or contractual duties as well as additional responsibilities. In other words, an employee's loyalty goes above and beyond what their employers require, both legally and morally. Moreover, the literature has identified some underlying factors that affect employee loyalty, directly or indirectly related to the organization's achievements and performance [21]. These include available career development and upgrading, motivation (intrinsic or extrinsic), job security, leadership support from supervisor/mentor/team members, and the organization's internal and external working environment [21,22]. So, the question is: can the leadership affect the HEI's output?

In light of this context, this investigation aims to carry out an empirical study on the relationship between academic loyalty and inclusive leadership in order to understand the support employees receive in HEIs. This research seeks to expand the understanding of perceived institutional support's (PIS) role as a mediator concerning academic loyalty and inclusive leadership. This article is outlined in the following order: Section 1 introduces the study, while Section 2 gives the background of the theory with some literature reviews and the research hypothesis. Section 3 provides the methodology, while Section 4 presents the results of the findings. Section 5 gives some discussions, while Section 6 covers the concluding remarks.

2. Theory

In this section, the theory behind this investigation is presented.

2.1. Conceptual Framework

Higher education is receiving increased attention, with more people seeking qualifications at HEIs. Furthermore, this trend can largely be attributed to trying to meet education goals set by the United Nations Sustainable Development Goals (SDG), particularly in higher education [2,23,24]. Despite this, these higher education institutions (HEIs) struggle to uphold their values and achieve global objectives [8,25,26]. Some of the reasons for these challenges are the lack of structural or institutional support received in HEIs, thus the need for the present study.

An earlier study identified an important aspect of student learning based on institutional support against the teacher's emotional support, seen through the mediating roles of perceived competence, autonomy support, and peer relatedness [27]. Similar study by Granziera et al. [28] considered the mediating effect (or role) which the perceived instrumental support as well as perceived emotional support from teachers in elementary schools, have towards students in terms of student engagement, academic buoyancy, and academic skills of the students using similar perceptual support approach. In another study, Yano et al. [29] looked at the perceived social support (PSS) received at the HEIs using a questionnaire obtained at a university campus to evaluate the safety perception using the multidimensional scale approach. In addition, recent studies investigated the impact of emotional support from the teachers on the students, which was described as perceived institutional support, as it helps improve their academic skill development, participation, and buoyancy [29–31].

Relevant studies have shown that academics who are emotionally committed to their institutions show heightened performance in teaching and research engagement, low absenteeism, and a reduced tendency to move to another institution [32]. As a direct result of this, academics are becoming more conscious of the level of commitment shown by their higher education institution (HEI) towards them in terms of approbation, compensation, accessibility towards library sources, accessibility to necessary information, new prospects, promotions, respect, values, and other types of assistance required for performing exceptionally well in their respective professions. It is noteworthy to add that the development of higher education has been supported by various organizations that promote quality guide-

lines for higher education [33–35]. These organizations support higher education, provide regular updates on higher education, and enhance the developments being made in HEIs, such as the Organization for Economic Co-operation and Development (OECD) [36–38] and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) [39–41]. Given this present study, the recent recommendation of UNESCO includes having a market-based and decentralized system in HEIs so that the educational system has a more flexible structure [42,43]. However, this present research seeks to consider adaptable theories to support it.

This study, therefore, builds on organizational support and social exchange theories as designed by Blau [44] and Eisenberger et al. [45], two earlier organizational management theorists. While organizational support theory (OST) presumes that, in "determining the organization's readiness to reward increased work effort and to meet socioemotional needs, employees develop global belief concerning the extent to which the organization values their contribution and cares about their well-being" [45], social exchange theory (SET) presumes that "people do not only maintain a relationship for personal interest but for friendship and the interest of the organization" [44]. Additionally, the SET assumes employees will trade under the norm or reciprocity on dedication and effort for physical and socio-emotional returns based on the relationship exchange with the employer/manager/leader [21,35,44]. Due to this, within the HEI context, where academics find leadership to be inclusive, they can perceive leadership support to achieve their physical and socio-emotional needs. The academics, based on SET, will most likely reciprocate the effort of the employer/manager/leader with a loyalty that will benefit and be in the organization's interest.

The literature indicates that according to the OST, "the development of perceived organizational support (POS) is encouraged by employees' tendency to assign the organization humanlike characteristics" [45]. Therefore, on a contextual basis, this study introduces the terms "perceived institutional support (PIS)" and adaptation of the "POS" by focusing on HEIs. The HEIs are considered differentiated forms of organizations acknowledged globally as part of an overall national innovation system where numerous theoretical, empirical, and normative questions emerge as knowledge, an asset needed for production [46]. Additionally, HEIs, like most organizations, rely on diverse and multidisciplinary individuals with various degrees of knowledge-based assets. However, they are more involved in developing, producing, and disseminating knowledge [11]. As a result, this differentiates academics from employees because their scholarly background and HEI engagement in learning, teaching, and research activities identify primarily with their individuality and not the HEI [14]. As such, the approach utilized here is considered.

Based on the present study, the effectiveness of structural equation modeling (SEM) has been validated because related studies on leadership, organizational culture, change management, and teaching methods in academic settings have utilized SEM to identify the effect of various factors on the system [47–50], as seen in Table 1.

Table 1. Themes for validating the structural equation modeling (SEM) in the study.

S/N	Themes	References
1	Leadership	[47,48]
2	Organizational Culture	[48]
3	Change Management	[48,49]
4	Teaching methods	[50]

However, there is a gap in applying this structural equation modeling (SEM) approach to perceived leadership in HEIs, which warrants the present study. In this research, the conceptual framework is illustrated in Figure 1, showing the perceived institutional support (PIS) from social exchange theories.

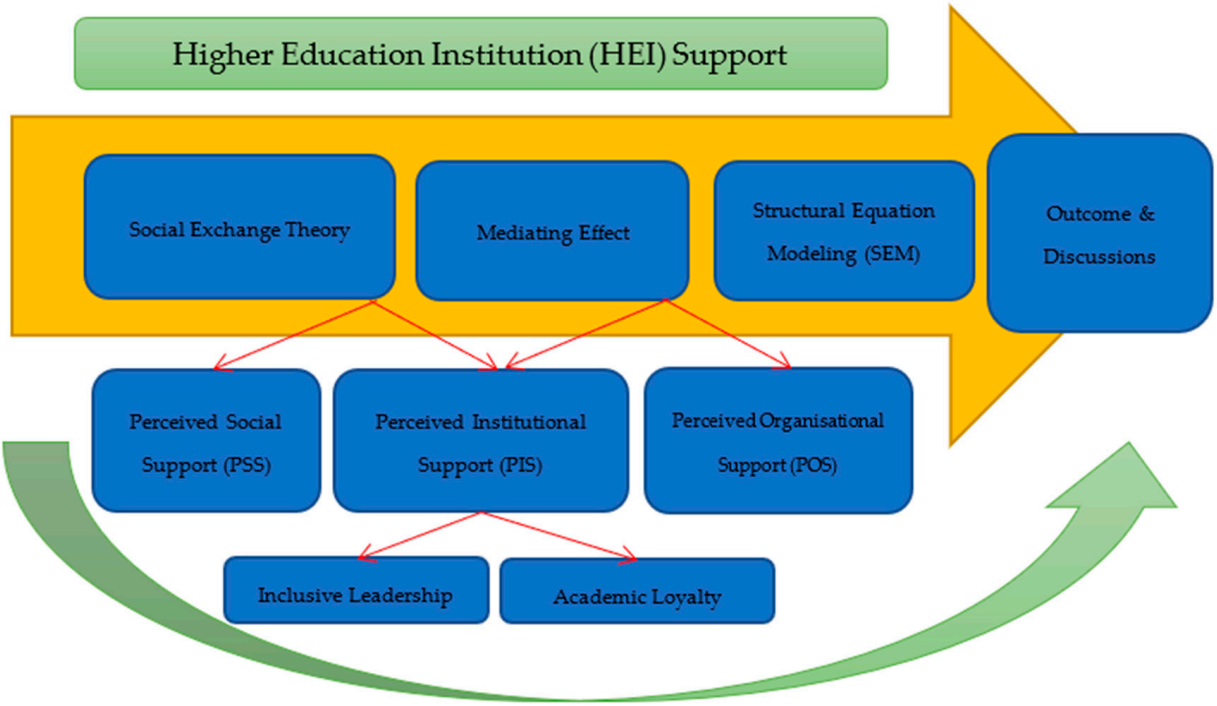

Figure 1. The study's conceptual framework is based on the adopted theories.

2.2. Inclusive Leadership and Academic Loyalty

Leadership is all about relationships. It is a continuous process of collective acquisition and knowledge exchange between leaders and subordinates [51]. However, most of the management and leadership research in HE is grounded in psychological and behavioral approaches that underestimate the dynamics of power and politics in shaping perception and enacting leadership [52]. The review of relevant literature indicates HE leadership is "an instrument to support 'planning', 'development', 'implementation' and 'evaluation' of academic work to achieve 'excellence' in the performance" [53]. Therefore, it can be concluded that the paramount role of leaders in the HE environment is to inspire their fellow academics to do groundbreaking studies, reach the highest standards of teaching, and produce innovative outputs.

Furthermore, it has been identified that a good leader must be adaptive to specific situations and the subordinates' needs to achieve a higher degree of effectiveness in meeting their individual and organizational goals [54]. HE leaders must be able to invigorate and energize their subordinates in both managerial and intellectual situations to get them actively involved in the collective processes, activities, and actions that will ensure adequate performance and quality standards in the institution. While the relationship between leadership, employee performance, and satisfaction has been documented extensively across various organizational sectors [55], our review of available literature indicates that no study has investigated the impact of inclusive leadership in HE that may influence academic loyalty.

An earlier study presented at an education conference by Gbobaniyi and Srivastava [16] considered two control variables in the institutional case of HEIs, which made a precursor for the present study based on the mediating effect of Perceived Institutional Support with inferences to be made on both academic loyalty and inclusive leadership from comparative analysis. However, this present study explores it in more detail. Studies in organizational behavior on leader-subordinate relationships identified that leadership breeds trust, thereby influencing employee performance, commitment, and satisfaction [56,57]. On the other hand, trust enables cooperative behavior, promotes a network-based approach, promotes more work outputs, and encourages problem-solving. In addition, trust lessens the likelihood of disputes, lowers the cost of transactions, makes it easier to organize ad

hoc groupings quickly, and encourages the development of efficient interventions for crises. Therefore, given that there is no universally agreed-upon definition of inclusive leadership, this study builds its definition of inclusive leadership in the literature as a form of leadership that guarantees team members are treated with respect and fairness, inspired to be innovative with the job, and can express their opinion even if it contradicts that of others or that of the organization [58]. Therefore, in the context of this HEI study, the authors argue that inclusive leadership is leadership that will foster the uniqueness of academics, strengthen their belongingness to the HEI, and influence academics to show support for the HEI's effort and contribution to their development [59]. However, available knowledge suggests that in the analysis of an inclusive leadership approach, its engagement and development in HEIs may exist in different forms and levels, including organizational or managerial leadership (executed through formal leadership positions), professional leadership (executed through upholding professional standards and performing in functional roles), intellectual and disciplinary leadership (expanding the boundaries of knowledge and conceptual understanding), personal leadership (based on credibility, charisma, expertise, and other qualities), team leadership (developed through collaborative agendas and working practices) and political leadership (building coalitions, networks, and social capital) [52]. Therefore, this study argues that with an inclusive leadership approach in HEIs, academics will have increased job satisfaction levels and loyalty because they are the primary and most-valued asset that brings about overall achievement and improvement to the institution [60–63].

On the other hand, academic loyalty can be described as an activity whereby some factors influence the attitude, thereby giving way for one's behavior to manifest. Building upon the definition of Allen and Grisaffe [64], we argue that academic loyalty is the mental condition that explains the relationship between academics and HEIs and affects their decision to remain in the institution. Existing literature discusses that in the past, once hired, academics saw their employment as a lifetime job, and managers also expected unstinted loyalty to the institution [65]. However, the idea of academic loyalty has transformed in academia with the start of globalization in HEIs, where institutions began to face restructuring due to internationalization, local and international partnerships, and relocations that have resulted in both the increase and downsizing of academics. The manifestation of the issues described earlier has brought about HEIs breaking the rules, where mutual obligations between HEIs and academics are being reconsidered and lifetime employment and devotion have become less expected. Moreover, it is known as "institution-hopping" as it is becoming something that is believed to be a common occurrence, and people who work in academia are always trying to improve their working circumstances and increase their remuneration. Metha et al. [65] indicated the internal and external dimensions of employee loyalty. The literature identified that the internal dimension of loyalty focuses on the emotional component (i.e., the feeling of caring, affiliation, and commitment), which is argued to be the dimension employers and managers must nurture and appeal to, while the external dimension is the way loyalty manifests itself (i.e., the behaviors that display the emotional component [65]).

Studies on organizational leadership and job satisfaction indicate a positive relationship between workplace climate, job satisfaction, and employee productivity when leadership is non-authoritarian, non-controlling, and supportive [66]. In simple terms, leadership impacts the employees' performance by cultivating an organizational atmosphere that people see as supportive of their growth and accomplishing their goals. Consequently, it is arguable that in environments where academics regard leadership as being non-authoritative, participatory, inclusion-based, and open to supporting teaching and research activities within that institution, there is a greater possibility for an increase in productivity. Furthermore, research has also shown that a 10% improvement in the perception of inclusion boosts employees' work attendance, heightens their value orientation, and increases their loyalty [58]. Following the discussion, it can be argued that when academics feel unvalued and the leadership is not open and non-supportive to their growth

goals and objectives, the likelihood of loyalty decreases, thus influencing the decision to transfer service by working with more HEIs. A further possibility is that they will need to switch to different HEIs where they perceive that support is more readily available. On the contrary, the likelihood of loyalty increases in institutions where the academic staff perceive themselves as valued and supported.

The literature review on global HEI rankings indicates that four main criteria are used to measure the ratings: quality of education, quality of faculty, research output, and academic performance [67]. Studies have indicated that HEIs may not be able to achieve good ratings and high rankings across these four main criteria if they do not provide the environment for their academics to be loyal to the institution [68,69]. In addition, Marconi and Ritze [70] indicated a positive relationship between an HEI's rankings and a list of factors that may impact the job satisfaction and loyalty of academics, including the HEI's expenditure per student, mission, size, and productive efficiency. The study emphasized that for an HEI to achieve productive efficiency, academics must have high job satisfaction and loyalty levels [70]. This has further generated arguments in the literature, as some studies have argued that the retention of academics, in essence, their loyalty to the HEI, is also positively related to an HEI's international outlook and influential ranking [61–63]. However, this study further argues that HEIs must ensure that leadership strategies are inclusive to promote academic loyalty, resulting in greater quality, a more global perspective, and a more influential ranking. Inclusive leadership helps to eliminate negative attitudes and views about race, ethnicity, sex, gender, sexual orientation, lifestyle, socioeconomic class, age, language, religion, disability, and their intersections [71,72]. Available knowledge indicates that inclusive leaders foster an open and approachable environment for the workforce, ensuring that workers feel psychologically comfortable voicing views that frequently do not align with the organization's established norms [10].

This study's review of HEI-related literature indicates that most HEIs adopt institutional leadership; that is, leadership is based on constrained agency, influence, or negotiated power and typically uses a backward-leaning vision to remind them of their core values [73]. However, the institutional approach to leading in HEIs has been argued to be a reason many have continuously been faced with increasing challenges, i.e., academic retention because the management approach and strategies do not adequately consider the diversity of the academic workforce in handling concerns and issues of their academics [74]. The review of relevant literature indicated that while some participants were satisfied with the leadership approach of their HEIs, others felt the absence of inclusive leaders and suggested that "inclusive leadership should concentrate on changing the work environment through engaging the minority of the academic members to act as a diversity change agent" [75]. This study suggests that where HEIs ensure a shift to an inclusive model of leadership that recognizes the leader as a significant factor in influencing the academic's experience and satisfaction in the workplace, the use of such an approach will ensure efficient operations that provide positive work-related outcomes and improved loyalty [76]. Hence, the study posits that higher education institutions (HEIs) that promote inclusive leadership will have an increased inclination to have a greater rate of academic loyalty compared to those whose leadership strategies do not involve an inclusive approach.

This present study aligns with the relevant literature on a causal relationship between inclusive leadership and academic loyalty and argues within the HEI context that PIS will help identify the underlying mechanism and better explain the relationship between them [77]. This research will make contributions to the literature in four aspects. Firstly, although knowledge in the literature indicates that inclusive leadership depicts a positive relationship with job satisfaction and commitment, work engagement, innovative behaviors, and well-being [78–81], there is yet no research to have investigated the extent to which inclusive leadership in an HEI setting influences the loyalty of academics. Secondly, this study advances knowledge on the scope of inclusive leadership in an HEI context, which has been indicated to not be well studied [75,82]. Thirdly, with inclusion research still regarded as developing, it may be deemed to be at the infant stage [83], with limited

empirical research on inclusive leadership [84]. This study contributes to and advances knowledge on the effects of inclusive leadership and academic loyalty. Fourthly, the paper makes contributions and advances the work on Perceived Institutional Support (PIS) in a HEI setting. To that end, this investigation places the following two hypotheses:

Hypothesis 1 (H1). *There are positive impacts of inclusive leadership on academic loyalty.*

In some HEIs, the literature review identified some studies that presented concerns that respondents shared and validated this hypothesis. The concerns include that they would have preferred having inclusive leadership in their institutions, as some colleagues get treated differently and disabled staff may not be fairly treated. The situations around such uneven treatment, unfairness, discrimination, etc., affect inclusion in HEIs. Additionally, there are issues of leadership having bottlenecks in the form of unnecessary bureaucracy for obtaining approvals for career advancements and professional development, as exists in developing nations. Other situations are the misuse of power or having an extreme rewards system in place, but relative to the locus. Though most existing studies in developing nations like Nigeria consider inclusive education but not inclusive leadership [85–87], there is a need to understand the relationship between inclusive leadership and HEIs. Thus, this hypothesis must be considered in this investigation.

Hypothesis 2 (H2). *The effect of inclusive leadership on academic loyalty is positively mediated by perceived institutional support.*

The discussions made using this hypothesis have shown the usefulness of inclusive leadership in HEIs. However, a particular aspect regarding the influence of inclusive leadership on academic loyalty was not considered in detail, looking at previous studies by various authors in this subject area [88–92]. Thus, there is a need for this investigation to be conducted. Following the model developed for the study, the hypothesis was first tested and confirmed. Figure 2 illustrates this research's hypotheses and the connection between academic loyalty, inclusive leadership, and perceived institutional support.

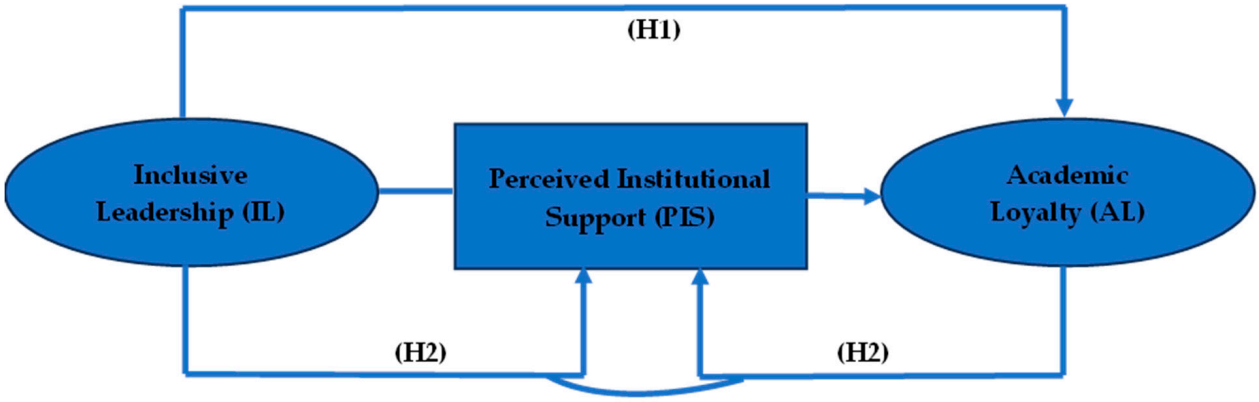

Figure 2. Proposed conceptual framework based on the research hypothesis.

The literature search indicates that more studies are suggested to understand the subject. There is currently less relationship seen in Figure 2 as proposed in the analysis; as such, further analysis is considered in the Section 2.3. Moreover, it is unclear which descriptors are needed for the indirect effects of inclusive leadership on academic loyalty. Similarly, that description requires more literature review to support this hypothesis. Thus, the results may be complemented by presenting direct, indirect, and total effects [93,94], but they are suggested for further studies as they are not part of the scope of the present study.

Additionally, conducting a bootstrap analysis would be recommended to ensure the validity of the mediation effects [95]. However, it is noteworthy to add that other concerns were not contained in earlier studies but exist in real-life leadership scenarios. Based on the presentation by Bourke and Titus [58], inclusive leadership can be inferred to be that form of leadership that has the characteristics of guaranteeing that team members are treated with respect and fairness, inspired to be innovative with the job, and can express their opinion, even if it contradicts that of others or that of the organization. To support the theoretical model earlier presented, academic studies have been used to validate the theories considered on leadership in HEIs. Different supporting studies exist that theorize inclusive leadership at different levels [88,89,96], its antecedents, and outcomes [59,92], including concepts of inclusive leadership [10,90].

2.3. Does Perceived Institutional Support Have Any Mediating Effect?

It is important to note that this section is a guideline to which this study is bound. After developing a theoretical framework for the contextual understanding of perceived institutional support (PIS) for higher education institutions (HEIs) by utilizing the theory of organizational support (OS), this study contends that perceived institutional support (PIS) is the inclination of the academic to attribute a humanlike quality to the HEI. This is because the OS theory suggests that employees develop a broad sense of how much their employer values their contribution and is concerned about their well-being to satisfy socio-emotional demands and properly appraise the benefit of higher work effort [97]. Given the consequence of this, the authors of the study contend that academics will be more inclined to interpret the actions carried out by an "agent of the HEI" or leader as a sign of the goal of the HEI rather than attributing those behaviors or actions to the motives of that leader. This implies that the leader might act outside the ambit of the HEI's procedure due to the leader's motivations, or non-inclusive leadership style. This action may affect how academics perceive institutional support. As discussed earlier, available knowledge from relevant literature indicated that participants felt non-inclusive, as there was little or no substantial change in the work environment that engaged academic members [75]. Building on this knowledge, we further argue that the concerns of the academics could be seen as an instance in which higher education institutions use the financial, moral, and legal responsibilities that are theirs contractually to aid and abet the actions of the HEI agents called "leaders", thereby encouraging behaviors that are not inclusive. This aligns with OS theorists' claim that employees personify their organizations, as they view satisfactory or unsatisfactory treatment as an indication of how the organization values them [32].

Furthermore, building on the extant literature on the OS theory that addresses the psychological processes underlying the consequences of the POS and that of this study's PIS, the study contends that the PIS produces a felt obligation to care for academics' welfare, which will also help the HEI achieve its objectives [98,99]. Therefore, the study contends that care from a personal and welfare perspective, such as work enrichments like "health insurance", salary or pay, and additional financial aid, are crucial from an academic's point of view. From a theoretical viewpoint, academics also desire to receive support for boosting their career development, professional profiles, and skills development. This is because academics want to be recognized as experts in their field. Academics are looking for opportunities to conduct research and financing for such research to collaborate and form partnerships with other relevant organizations, institutions, or government authorities. This will allow academics to have more of an impact on broader areas of sustainable education. This will also cover environmental, economic, and social policies attuned to HEIs. Subsequently, if academics perceive a general belief regarding their HEIs' commitment to them to help reaching their desired goals, there is an enhanced possibility for such academics to have a higher obligation to their work and be loyal to the HEI. This is because there is a correlation between academics' perceptions of a general belief regarding their HEIs' commitment to them for support and academics' likelihood of being more committed to the job they do.

Secondly, this study contends that the PIS connotes approval and respect that fulfill academics' socio-emotional needs, allowing them to incorporate their membership in the HEI and its status into their social identity [100]. Furthermore, following knowledge from organizational learning literature, the study argues that PIS is a structure of organizational learning. The literature indicates that organizational learning refers to the process through which organizations create, acquire, and transfer knowledge to reflect new knowledge and ideas [101]. While Confessore and Kops [102] argued that a learning organization is characterized by teamwork, cooperation, innovation, and an information-based process, Jensen [103] contended that a learning organization ensures the continuous capacity to create knowledge by motivating employees to transfer information into new knowledge. The authors of this study, therefore, argue that only an HEI that promotes inclusive leadership will be able to have such characteristics and provide structures that ensure academics perceive institutional support through a formal system of training and development [96]. Additionally, an informal system could be provided for employees to share work advice in casual conversations, making management-based academics aware of both the leadership style and institutional support available to them [75]. Due to this, academics have the mindset that they are top achievers; as a result, they would like to be recognized for their performance and have a sense that they are valued within the institutions in which they work. When an academic perceives that the HEI recognizes excellence and provides necessary support towards achieving their goals, the likelihood of loyalty to the institution increases. Moreover, they will remain in their positions for longer and be pleased to claim the HEI as part of their societal identity to keep up with the demands of their professional or social circle.

Furthermore, this study argues that academics' conviction in the validity of the performance-reward system would be bolstered by PIS because, in a situation where an academic produces an excellent performance, the individual endows trust that the HEI will recognize and value such performance with a commensurate reward that motivates future performances. Where such performance-reward expectations are met, the particular and other academics in the institution become motivated toward ensuring excellence in their performance, and this will further increase their loyalty to the HEI. This aligns with what an earlier study found, which is that motivation lends any human action both support as well as meaning [104]. Where the appropriate substance is in place to motivate and support action, employees view such an organization's leadership as providing them with the environment to achieve not only the organizational goals but also those of the employees.

In the context of academics, they want leadership that guarantees support and a fair opportunity for their continuous professional development in teaching and research. Additionally, our position aligns with Vroom's Expectancy Theory, which assumes that the choice of work behavior is a function of the individual's expectations and assessments regarding potential rewards [105]. In this study, it was argued that academics expect to have a work environment that supports their efforts to achieve their long-term career goals, where the leadership is inclusive and acts as an instrumentality for openness, fairness, and respect. This study contends that when leadership is seen as inclusive, it fosters an open and approachable environment for the workforce, ensuring that workers feel psychologically comfortable voicing views that frequently do not align with the organization's established norms [10].

3. Methodology

In this section, the methodology is presented, and the flowchart for the investigation is given in Figure 3.

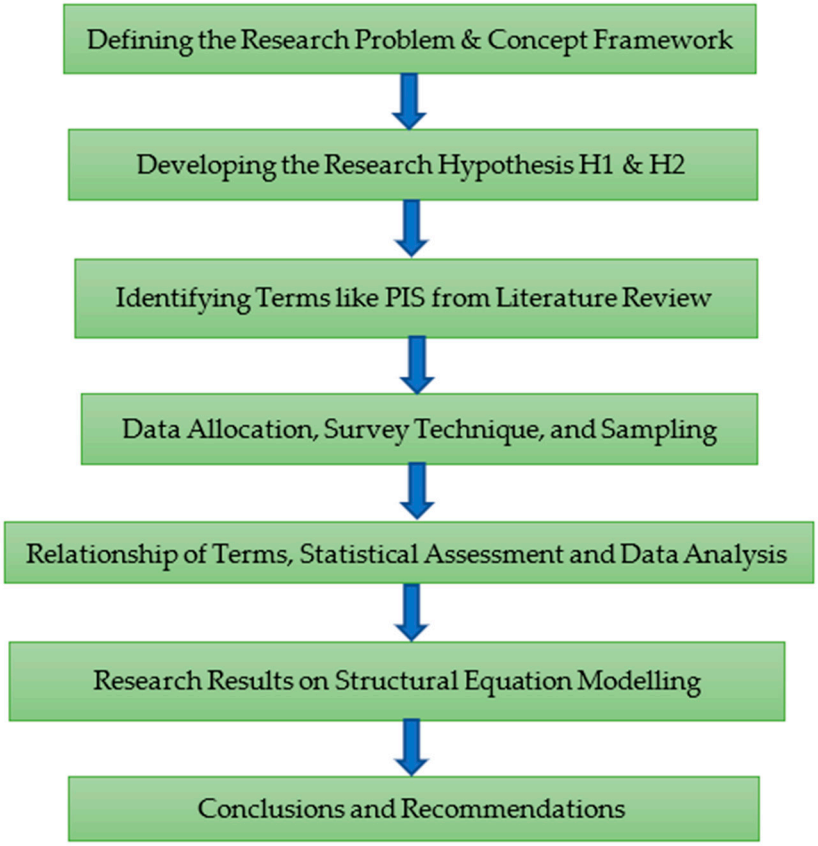

Figure 3. The methodological flowchart for the study.

3.1. Data Samples and Sampling Techniques

A purposive sampling technique was adopted for this study. The sampled respondents comprised full-time academics randomly selected through LinkedIn from different HEIs globally. Each participant with visibility that is aligned with a higher education institution stands a chance of being selected for investigation. A total of 642 academics were contacted and sent questionnaires to complete. While all the participants for this study were sourced through LinkedIn, as a preventative remedy for common method bias, the researcher requested follow-up interviews to understand how academics feel about loyalty to their respective HEIs, reduce the effect of their desire for consistency, and minimize the potential for common method bias [106]. However, only 78 participants (41 from the UK, 12 from the Republic of Ireland, 3 from Saudi Arabia, 4 from Egypt, 8 from South Africa, 1 from Germany, 6 from Canada, and 3 from the US) agreed to interact with the research team. Out of the administered questionnaires, only 402 (63%) were fully completed and returned and were found valid for data analysis. Notably, using the purposive sampling technique requires more information on the sample characteristics, such as institutional characteristics/disciplines and respondent background characteristics. This study gave details about the sample's response rates, and the sample characteristics are full-time.

3.2. Likert Scale and Criteria Setting

In this study, the scale used for measuring the data, coding the terms, and applying the statistical methods utilized were selected based on the key elements considered. To measure inclusive leadership, a nine-item inventory was developed by adapting Carmeli et al.'s [10] measure of inclusive leadership, aiming at assessing three dimensions of inclusive leadership: accessibility, openness, and availability. Several key questions, which included the respondents' choice of leadership, were based on a five-point Likert scale as "1—Definitely Inclusive"; "2—Somewhat Inclusive"; "3—Not sure"; "4—Somewhat Institutional"; and "5—Definitely Institutional". One of the questions that were asked

concerned the type of leadership that respondents said was displayed by the line managers (head of department, dean, or associate dean). The findings of our factor analyses led to the discovery of a one-factor solution with an Eigenvalue of 6.07, which explained the reason for the variance of 69.73%, as such variation was high for the factors, and it has a factor load range of 0.57–0.83. This measure received a score of 0.93 on the Cronbach alpha test, which is comparable to the score of 0.94 that Carmeli et al. [10] acquired.

To measure academic loyalty, an eight-item inventory was developed by adapting Matzler and Renzl's [55] measure of employee loyalty to assess the relationship between trust, satisfaction, and loyalty. Several key questions were posed to the participants, including the respondents' length of service at their HEIs and the likelihood that they will remain with the institution. In addition, the respondents were posed the question of whether their chance of staying longer with the institution would be purely impacted by issues involving the HEI, or whether it would be solely influenced by concerns concerning its existing leadership. Applying the scale from 1 to 5, based on a similar five-point Likert scale, the responses were as follows: "1—less than 3 months"; "2—between 3 and 6 months"; "3—between 6 and 12 months"; "4—between 1 and 3 years"; and "5—more than 3 years". This measure had 0.89 as its value for the Cronbach alpha.

3.3. Research Tools and Method

In this paper, the research tools utilized were selected based on the measured factors considered. The research tools used for the analysis of the data were SMART PLS and Statistical Package for Social Science (SPSS) v26. The research method was presented following the American Psychological Association (APA)'s specified procedure [107]. However, this study was not preregistered and was based on the questionnaire data gathered.

To measure perceived institutional support (PIS), the authors developed a 12-item inventory by adapting an established Survey of Perceived Organizational Support (SPOS) from earlier research [98]. This study adopted Rhoades and Eisenberger's [32] recommendation for its 12-item inventory compared to Eisenberger et al.'s [98] 36-item SPOS. As the original scale is unidimensional and has high internal reliability, the use of shorter scales will not be problematic. Given the consequence of this, the investigation transforms the constructs of POS onto those of PIS, and it makes certain that the aspects that define the concepts of POS and PIS (such as the academic work contributions made, the value of employees, staff recognition, and care) are reflected in the 8-item scale in the study's questionnaire that we used. Some examples of what is included are as follows: The contributions from employees to the HEI's overall performance and rating are valued, and the HEI is concerned about the employees' level of job satisfaction at the HEI, as well as taking steps to ensure that the employees have access to all the necessary resources for working. The researchers devised a Likert SCALE with five points, ranging from "1—Strongly disagree" to "5—Strongly agree", with the intention of rating respondents' opinions. In addition, we determined the PIS using the Cronbach coefficient alpha, and the value that we obtained was 0.89.

Based on Carmeli et al. [10], variables were selected for the present investigation. Thus, our study's variables included control variables, including respondents' age (using a four-item inventory), level of qualification (four-item inventory), and length of service (six-item inventory). The respondents' age was considered in this research because the authors hypothesize that older academics may have a greater propensity towards an institutional leadership style, while younger academics might have a greater propensity towards a leadership approach that is more inclusive in nature and inclination. The level of qualification (i.e., whether the respondents are bachelor-, master-, or doctorate-level degree holders) was controlled, as this study argues that academics with different educational qualifications behave differently. Academics with a relatively low educational qualification level might be more likely to look to institutional leadership for guidance. On the other hand, academics with a relatively high educational qualification level might be much more likely to adopt an inclusive leadership style. Based on the other factor, the length of service

was controlled, as the authors argue that while academics who have stayed longer with a particular HEI may not be bothered about the impact of leadership in the HEI, those who have stayed for a lesser number of years may easily become weary of the direction and impact of leadership towards their academic goals and achievements.

The SMARTPLS as well as Statistical Package for Social Science (SPSS) 26 were utilized for the data analysis. To assess the validity and reliability of measurement scales, exploratory (i.e., varimax rotation) and confirmatory (i.e., Kaiser Meyer Olkin, Bartlett's test of sphericity, eigenvalues, variance explained, and Cronbach alpha) methods were used [108]. To assess the research variables and the suitability of the data set as a post-hoc technique to avoid the problem of the common method variance (CMV), correlation and confirmatory factor analysis (CFA) marker techniques and descriptive statistics were conducted [109]. Based on the model for this article, SEM was utilized to estimate the research models. The study employed a two-way approach to SEM, where it assessed the construct validity using confirmatory factor analysis and then compared the sequence of nested structural models [110,111]. To remove the issues associated with using a single goodness-of-fit index in SEM [112], the study employed multiple goodness-of-fit indices [113]. To that end, the present investigation utilized measurements adapted from related references of organizational work and higher education settings (for instance, [10,32,55,98]).

4. Results

The data in Table 2 show the findings conducted on a measurement scale for the reliability tests and validation tests. Following the guideline from Hair, et al. [114], the result of our statistical analyses indicated that (a) the value of factor analysis for all items that represented each variable was more than 0.5, indicating that the items were of the acceptable standard of validity analysis; (b) all research variables were above the acceptable standard of KMO test value of 0.6 and were significant in Bartlett's test of sphericity; (c) the Eigenvalue for all research variables was greater than 2 and the items for each variable exceeded factor loadings of 0.50 [114]; and (d) the acceptable standard of reliability analysis for all research variables exceeded 0.70 [54]. As shown in Table 2, the instruments used in this study were reliable, as they exceeded the acceptable level of 0.70, with Cronbach coefficients ranging from 0.72 to 0.84 [115].

Table 2. Findings of the reliability tests and validation tests conducted on the measurement scale.

Variables	Items	Factor Loading	KMO	Bartlett's Test of Sphericity	Eigen Values	Variance Expressed	α Coeff. Cronbach
Inclusive leadership (IL)	9	0.74	0.76	312.17 **	2.42	62.13	0.77
Academic loyalty (AL)	8	0.85	0.78	276.39 **	3.22	71.52	0.76
Perceived Institutional Support (PIS)	12	0.71	0.81	387.41 **	2.71	57.43	0.84
Age	4	0.82	0.75	209.13 **	3.41	64.88	0.79
Qualification level (QL)	4	0.69	0.73	294.15 **	2.15	75.19	0.81
Length of Service (LS)	6	0.77	0.86	338.84 **	2.56	69.12	0.72

Note: ** significant at 0.05 levels.

Table 3 gives the correlation made, reliability found, standard deviation obtained, and mean values. The values in Table 3 show the range of research variables that were considered in this investigation. According to the results of the bivariate correlations, inclusive leadership has a positive association with the two items, namely the loyalty of employees ($r = 0.41$, $p < 0.01$) and their perceptions of the support of the institution ($r = 0.03$, $p < 0.01$). Additionally, the findings indicated that an optimistic correlation existed

between employee loyalty and the degree to which institutional support is perceived by them (r = 0.22, $p < 0.01$).

Table 3. Values on the correlation, standard deviations, and means.

Variable	Means	S.D.	1	2	3	4	5	6
IL	3.670	0.790	1					
AL	3.130	0.810	0.410	1				
PIS	2.780	0.720	0.030	0.220 *	1			
Age	36.130	7.090	−0.000	0.320 **	−0.060	1		
QL	3.770	0.880	0.050	0.020	0.010	0.330	1	
LS	8.460	4.610	0.110 **	0.360	−0.000	0.040	0.220 **	1

N—number of respondents = 402, S.D.—Standard Deviation, ** $p < 0.01$, * $p < 0.05$, type: two-tailed test.

Confirmatory factor analysis (CFA), was applied to determine whether or not each measurement item was going to significantly unload onto the rating scales. This was done to provide further proof of the construct validity of the latent factors used in this investigation. Based on this CFA study, the findings of the entire CFA demonstrated an acceptable match with the available data, as RMSEA = 0.083; TLI = 0.926; NFI = 0.911; CFI = 0.932; GFI = 0.901; and CMIN/df = 2.774. This is based on the recommendation that CMIN/df must be less than 3 (i.e., CMIN/df < 3) and both values of CFI and TLI must be greater than 0.9 (i.e., CFI > 0.9; TLI > 0.9), RMSEA must be between 0.05 and 0.08, and the standardized coefficients from items to factors must range between 0.45 and 0.98 [108,116]. Additionally, the CFA revealed that each indicator variable's link with its corresponding construct was significant ($p < 0.01$), demonstrating the hypothesized relationships between indicators and constructs and, thus, confirming convergent validity [117].

Based on this study, a comparison was made between the fit of the study's measurement model and another two-factor model, in which items measuring academic loyalty and inclusive leadership were added to one component, and questions measuring PIS were added to a second factor. At that stage, the fit of this model was somewhat low and much worse than the proposed three-factor model. The results were: RMSEA = 0.121; TLI = 0.820; NFI = 0.842; CFI = 0.834; GFI = 0.812; and CMIN/df = 2.023; both the CFI and TLI values are lower than 0.90 (i.e., CFI < 0.9; TLI < 0.9), while the RMSEA value is less than 0.05 (RMSEA < 0.05). We assessed a one-factor model for common method bias by using Harman's one-factor test for common method bias. In this model, all of the questions that measure inclusive leadership, academic loyalty, and perceived institutional support were combined into a single component. The goodness-of-fit analysis conducted on the model was not encouraging, just like the one before it, and it was even worse than the recommended three-factor model, with the following values: RMSEA = 0.162; TLI = 0.623; NFI = 0.683; CFI = 0.718; GFI = 0.791; and CMIN/df = 2.120. It is possible to conclude that the hypothesized three-factor measurement model had superior goodness of fit with the data compared to the two-factor measurement model and the one-factor measurement model. The results from the modeling of this study are presented in Figure 4.

Previous research that bore on this subject (such as James et al. [118]) examined the hypothesized mediating connection using several comparisons for the nested model. This is because mediating models using SEM allows for the analysis of complex models, control for measurement error, specification of relevant paths, and avoidance of under/overestimation of moderation effects ([119]). The first thing that was done was testing the hypothesized mediating model, in which the role of perceived in-institutional support (PIS) was specified as a mediator for the association between academic loyalty (AL) and inclusive leadership (IL). This model also includes the control factors for academic loyalty: length of service (LS), qualification level (QL), and age. In this investigation, these three variables were defined. The findings, which are presented in Table 4, suggest that the model provides a satisfactory

match to the data: CMIN/df = 2.768; GFI = 0.891; CFI = 0.919; NFI = 0.908; TLI = 0.923; RMSEA = 0.081.

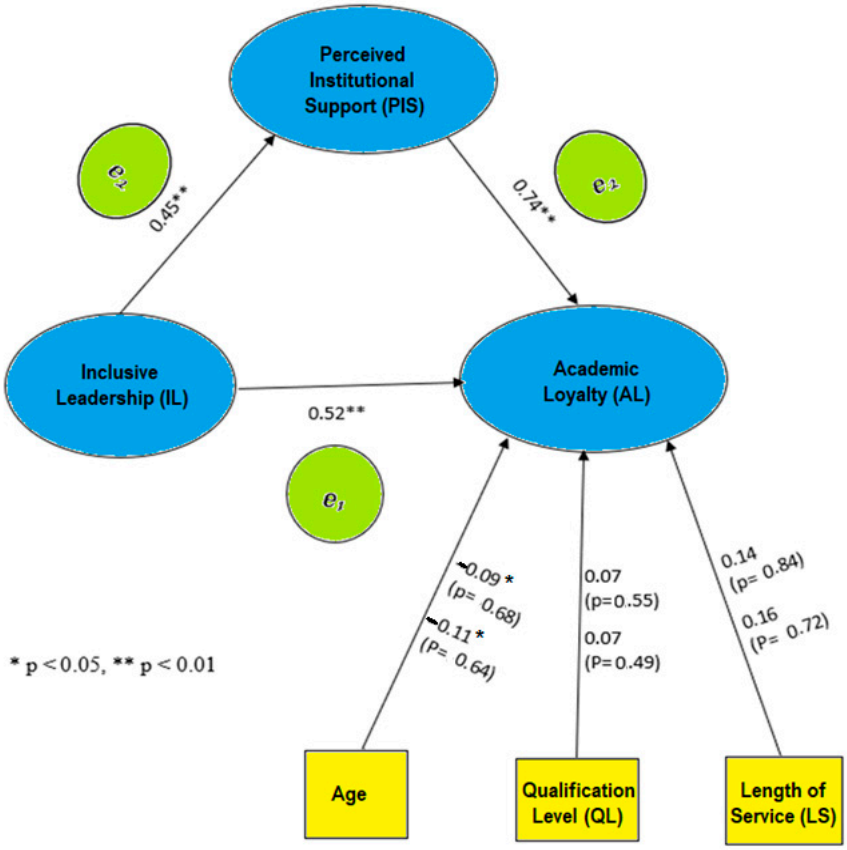

Figure 4. Relationship between the measured models (where e_1 is Hypothesis 1, e_2 is Hypothesis 2, * $p < 0.05$, ** $p < 0.01$).

Table 4. Comparing different structural equation models and calculating the path coefficients to test the moderating models.

First Hypothesis Model (e_1)		Second Hypothesis Model (e_2)	
IL → AL	0.520 **	IL → PIS	0.450 **
-	-	PIS → AL	0.740 **
-	-	IL → PIS → AL	0.360 *
Age → AL	−0.09 (p = 0.680)	Age → AL	−0.11 (p = 0.640)
QL → AL	0.07 (p = 0.550)	QL → AL	0.07 (p = 0.490)
LS → AL	0.14 (p = 0.840)	LS → AL	0.16 (p = 0.720)
CMIN/df	2.7740		2.7680
RMSEA	0.0810		0.0810
GFI	0.9010		0.8910
CFI	0.9320		0.9190
NFI	0.9110		0.9080
TLI	0.9260		0.9230

The control variables (length of service, qualification level, and age) were linked to academic loyalty. ** $p < 0.01$, * $p < 0.05$. AL—Academic loyalty; PIS—Perceived Institutional Support; IL—Inclusive leadership. QL—Qualification Level; LS—Length of Service; CMIN/df—Chi-square goodness-of-fit statistic/degree of freedom; RMSEA—Root Mean Square Error of Approximation; GFI—Goodness-of-fit Index; CFI—Comparative Fit Index; NFI—Normed Fit Index; TLI—Tucker-Lewis Index.

The results of the hypothesized models have been shown in Figures 2 and 4, as well as in Tables 4 and 5. Based on the models that were hypothesized, the direct effect of the path was significant from IL to AL, with a value of 0.52 and a probability less than 0.01. The outcome of the hypothesized model lends support to Hypothesis 1, which says that inclusive leadership has a beneficial effect on academic loyalty. In addition, the findings demonstrated that the direct impacts of the pathways IL to PIs and PIS to AL correlated 0.45 while being significant at $p < 0.01$, as well as having a correlation of 0.74 and a significance value of $p < 0.01$, respectively. Both paths led to the same conclusion.

Table 5. Total, indirect, and direct effects.

	Standardized Coefficient	T-Statistic	Lower Bounds	Upper Bounds	*p*-Value
Direct effect					
IL → AL	0.52	3.43	0.31	0.52	0.01
IL → PIS	0.45	2.86	0.18	0.24	0.01
PIS → AL	0.74	4.35	0.36	0.55	0.01
Indirect effect					
IL → PIS → AL	0.36	2.07	0.09	0.17	0.01
Total effect					
IL → AL	0.78	4.63	0.38	0.57	0.01

Considering the recommendations made by Aboramadan et al. [75], the authors performed a calculation of the indirect effects using a 5000-bootstrapping approach at a 95% confidence level. This was done to test the mediating effect. Table 4 gives a rundown of the findings obtained in the present investigation. The findings indicated that perceived institutional support (PIS) significantly and positively mediated the connection between academic loyalty and inclusive leadership, with a correlation of 0.36, a significance level of $p < 0.01$, and a confidence range ranging from 0.09 to 0.17. This finding lends credence to Hypothesis 2, which states that PIS is a positive moderator of the relationship between academic loyalty and inclusive leadership. Finally, regarding the control variables, while age showed negative significance, both length of service and qualification level were positively significant towards both the direct and mediating effects. It is noteworthy to add that the pathways for modeling the variables using the hypothesis were included in an earlier study [16], which was used to calculate the path coefficients while testing the mediating effects of the moderating models.

5. Discussion

The primary goal of this investigation is to find out the mediating effect of perceived institutional support on inclusive leadership and academic loyalty, as well as the impact of inclusive leadership on academic loyalty. The results of this investigation indicate strong backing for each hypothesis, as the derived outcome indicates that inclusive leadership is significant as well as having a positive impact on academic loyalty. This result is supported by previous research that has identified that when leadership is open, participative, and inclusive, employees become satisfied and feel happy to stay and work for the organization, thus resulting in loyalty [21,120,121].

This study's theoretical contributions are based on the underpinning theories of the OST and the SET. There have been studies that have investigated the relationship between inclusive leadership and employee loyalty within an organizational setting [10], the relationship between interpersonal trust, employee satisfaction, and employee loyalty [55,122], and the relationship between job satisfaction, organizational commitment, and employee loyalty [21,64,123,124]. However, no study has been identified to investigate the aggregate connection between PIS, academic loyalty, and inclusive leadership within an HEI context.

This study contributes to the available studies showing that inclusive leadership, as a situational support factor, enhances academic loyalty. Furthermore, the study advances research with its theory-based development of the PIS in HEIs by examining its potential intervening role in the connection between academic loyalty and inclusive leadership. This study's findings may pique scholars' interest in the significance of perceived institutional support to increase academic loyalty in HEI settings in terms of leadership and management.

The institutional and managerial implications of this research will help the leadership of HEIs recognize the impact of the loyalty of their academics. The first institutional/managerial implication is for the HEI management to understand that the leadership approach is a factor that affects academic loyalty. Therefore, leadership in HEIs should adopt an inclusive mindset. Additionally, regarding the highly competitive nature of higher education institutions (HEIs) in attracting and retaining outstanding academics, the stakeholders are responsible for ensuring that academics regard these institutions as helpful to make them dedicated and loyal to their institution of higher education. This can be done through their representatives or by appointing departmental heads. Leadership styles and methods make a significant difference; consequently, departmental heads are responsible for ensuring inclusiveness because that enables academics to gain insight into the institutional support that is available and readily accessible to them. This will assure the academics that their accomplishments will be considered, the efforts they put in will be appreciated, and their students' support will be appropriately recognized.

Furthermore, HEI management requires loyal academics who will stay to help the institution pursue and achieve its vision, mission, and objectives. Based on the reciprocity of the relationship exchange and relationship between performance and reward of Vroom's expectancy, OS, and SE theories [105], academics also require HEI management to be open, participative, and supportive of them to achieve their individual growth goals. As a result, where academics identify that the HEI supports them in achieving their individual growth goals and objectives, they will also be loyal to the HEI to ensure that it achieves its vision, mission, and objectives. Secondly, the additional implication for management is the duty that those in charge of higher education institutions are obligated to give and demonstrate to academics that the working conditions satisfy the academics' needs by providing them with opportunities for their continuous professional development in teaching, learning, and research activities. This will ensure increased dedication, commitment to their job roles, and loyalty to their HEIs. This is because when academics are not satisfied with their working conditions and are not psychologically safe, as they cannot perceive institutional support, their work focus diminishes and the likelihood for them to move to another HEI increases, thus reducing loyalty. The third implication for HEI management is that, from an HE perspective, their students' success, progression, and retention are paramount. Therefore, HEI management must ensure they retain their academics as they become assets to the establishment and promote the institution's profile and recognition. HEI management should ensure they provide a competitive work package that will motivate academics to remain loyal.

Some of this investigation's limitations should be emphasized to create the potential for future investigation. Foremost is the selection of research samples randomly done using academics' LinkedIn profiles. The choice of academics indicates good diversity. However, they were unevenly selected from different countries. Due to this, this study's findings may suffer from generalization to HEIs in any of the individual countries. Second, another limitation of the investigation is the number of variables used: one dependent, one core independent, one meditating, and three control variables. The choice of variables has been identified by basing the existing studies central to related studies on loyalty. This study, however, assumes that other variables may also affect the relationship with academic loyalty, and other variables, like employee empowerment, are suggested for further study. Some themes related to the research variables are given in Table 6.

Table 6. Some themes related to the research variables.

S/N	Themes	References
1	Employee involvement	[10,123,125]
2	Job satisfaction	[54,126,127]
3	Job empowerment	[128,129]
4	Teaching methods	[130–133]
5	Learning methods	[134–137]
6	Bibliometric study on learning	[130–136]
7	Organizational culture	[18,48,138,139]
8	Mediating effect	[10,27–29,48,76,77,140]
9	Sustainable education	[12,15,24,26,86,141–143]
10	Sustainable leadership	[13–15]

The present study also posits that sustainable education would be enhanced by having institutional support and leveraging digital tools to achieve sustainability practices, i.e., smart building automation, building information modeling, scholarship of teaching and learning (SoTL) as well as shifting most educational activities to the digital space [136,137,141,142]. Third, an in-depth analysis could be obtained by utilizing the mixed research method or by collecting qualitative data on how institutional support is perceived and its impact on inclusive leadership to influence academic loyalty. Finally, this study engaged academics from different countries to have a wider spectrum of HEI practices. The investigators suggest conducting another country-based research to further validate and corroborate the results of this investigation by replicating it in one country to compare it with the results of this study.

Thus, further studies on the aspects of inclusive leadership in HEIs that can be looked at can be localized to the European setting or the African setting. In the African environment, for instance, perceived institutional support can be applied to the leadership style, as seen within the Igbo setting in the eastern parts of Nigeria, with different recognized leadership styles, such as "Igwebuike" [144–146], which implies 'strength in unity' in Igbo language. Hence, future studies could be considered on various localities, countries, and ethnicities on inclusive leadership in HEIs. Additional areas to consider in future studies include the influence of KPIs and other metrics in measuring performance in HEIs, as well as preparing bibliometric studies in this area in relation to institutional support in HEIs.

Based on the control variables and the results, further studies should be conducted on the effect size of the coefficients obtained on the mediators. It is noteworthy to add that the research population was administered the questionnaires after the completion of the research instruments. As a result, it is recommended that future studies consider an alternative approach to the selection of respondents. Additionally, this study considers age a limitation because its effects were controlled. The study assumes the age of the respondents may influence loyalty and perception of institutional support based on their life experiences, thus considering age as an area to explore in future research.

6. Conclusions

With the rising desire for qualifications from universities and other HEIs, and the need to attain sustainable education as globalization increases, it becomes imperative to understudy the institutional support in higher education institutions (HEIs). This investigation explores the impact of perceived institutional support on academic loyalty and inclusive leadership in HEIs. Perceived institutional support was theorized to serve as a mediating variable in the correlation between inclusive leadership and academic loyalty. Using the sampled global academics randomly selected online from different HEIs through LinkedIn, descriptive statistics and correlation analysis were used to assess the suitability of

the dataset and the research variables. Structural equation modeling (SEM) was employed to estimate the relationship between the models. The study's findings provided evidence in favor of the first hypothesis of the research, which stated that inclusive leadership has a favorable effect on academic loyalty. Similarly, the research outcomes provided evidence to support the second hypothesis, which stated that perceived institutional support has a mediating beneficial impact on the influence of inclusive leadership on academic loyalty. According to the findings, a positive relationship exists between academic loyalty and inclusive leadership. While a positive association exists between PIS and academic loyalty and inclusive leadership, there is also an inference that institutional support exists.

The contributions made to knowledge from this study are given herein. The results of this investigation are helpful to every HEI stakeholder in formulating policies to improve upon, having applicable impacts with increased productivity, achieving targets in terms of key performance indicator (KPI), and improving institutional performance. This study is useful to stakeholders in higher education institutions (HEIs) in formulating relevant policies to improve the productivity and performance of their institutions. This paper is of high significance as it presents an original work on applying SEM to investigate the influence of perceived institutional support on academic loyalty and inclusive leadership in HEIs. It portrays areas where teacher support can be enhanced to improve institutional performance, thereby meeting the KPIs. Policies on sustainable higher education can also be considered from the perspective of the HEI employees to enhance the teaching profession. Additionally, the originality of this study indicates that the role of perceived institutional support for academics is significantly important and provides valuable support for academics to overcome their professional developmental challenges. As a result, rather than continuing to focus on the performance and productivity of academics, stakeholders in HEIs should refocus on the leadership structures, patterns, and styles to ensure academics are aware of the support available to them for their development, which will encourage their loyalty and retention to the institution.

The study also presents some limitations, highlighting the need for future research opportunities. Firstly, the selection of research samples was randomly done using academics that have profiles on the professional social media platform, LinkedIn. The choice of academics indicates good diversity; however, they are unevenly selected from different countries. Due to this, the results of this investigation may suffer from generalization to HEIs in any of the individual countries. Secondly, another limitation of this investigation is the number of variables used: one dependent, one core independent, one meditating, and three control variables. Thirdly, examining the behavior in one country rather than many countries could be investigated in further studies. Fourthly, collecting qualitative data or engaging in a mixed research method would provide an in-depth analysis of how institutional support is perceived and its impact on inclusive leadership to influence academic loyalty. Fifthly, further study is recommended on the mediating effect which the perceived support has on student retention in HEIs. Lastly, future research is recommended in applying SEM using other learning, research, and training variables in HEIs.

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References

1. Chankseliani, M.; McCowan, T. Higher education and the Sustainable Development Goals. *High Educ.* **2021**, *81*, 1–8. [CrossRef] [PubMed]
2. Cottafava, D.; Ascione, G.S.; Corazza, L.; Dhir, A. Sustainable development goals research in higher education institutions: An interdisciplinarity assessment through an entropy-based indicator. *J. Bus. Res.* **2022**, *151*, 138–155. [CrossRef]
3. Leal Filho, W.; Salvia, A.L.; Eustachio, J.H.P.P. An overview of the engagement of higher education institutions in the implementation of the UN Sustainable Development Goals. *J. Clean. Prod.* **2022**, 135694. [CrossRef]
4. Alam, G.M. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh-a comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef] [PubMed]
5. Ruiz-Mallén, I.; Heras, M. What Sustainability? Higher Education Institutions' Pathways to Reach the Agenda 2030 Goals. *Sustainability* **2020**, *12*, 1290. [CrossRef]
6. Bergan, S.; Damian, R. *Higher Education for Modern Societies: Competences and Values*; Council of Europe: Strasbourg, France, 2010; Volume 15. Available online: https://rm.coe.int/higher-education-for-modern-societies-competences-and-values/168075dddb (accessed on 26 August 2023).
7. Popov, N.; Wolhuter, C.; de Beer, L.; Hilton, G.; Ogunleye, J.; Achinewhu-Nworgu, E.; Niemczyk, E. New Challenges to Education: Lessons from around the World. BCES Conference Books, Volume 19. Bulgarian Comparative Education Society. 2021. Available online: https://files.eric.ed.gov/fulltext/ED613922.pdf (accessed on 26 August 2023).
8. Chankseliani, M. International development higher education: Looking from the past, looking to the future. *Oxf. Rev. Educ.* **2022**, *48*, 457–473. [CrossRef]
9. Kezar Adrianna, J.; Elizabeth, M.H. *Shared Leadership in Higher Education: Important Lessons from Research and Practice*; American Council on Education: Washington, DC, USA, 2017.
10. Carmeli, A.; Reiter-Palmon, R.; Ziv, E. Inclusive leadership and employee involvement in creative tasks in the workplace: The mediating role of psychological safety. *Creat. Res. J.* **2010**, *22*, 250–260. [CrossRef]
11. Middlehurst, R.; Goreham, H.; Woodfield, S. Why research leadership in higher education? Exploring contributions from the UK's leadership foundation for higher education. *Leadership* **2009**, *5*, 311–329. [CrossRef]
12. Alam, G.M. Sustainable Education and Sustainability in Education: The Reality in the Era of Internationalisation and Commodification in Education—Is Higher Education Different? *Sustainability* **2023**, *15*, 1315. [CrossRef]
13. Iqbal, Q.; Piwowar-Sulej, K. Sustainable leadership in higher education institutions: Social innovation as a mechanism. *Int. J. Sustain. High. Educ.* **2022**, *23*, 1–20. [CrossRef]
14. Leal Filho, W.; Eustachio, J.H.; Caldana, A.C.; Will, M.; Salvia, A.L.; Rampasso, I.S.; Anholon, R.; Platje, J.; Kovaleva, M. Sustainability Leadership in Higher Education Institutions: An overview of challenges. *Sustainability* **2020**, *12*, 3761. [CrossRef]
15. Alam, G.M. The Relationship between Figureheads and Managerial Leaders in the Private University Sector: A Decentralised, Competency-Based Leadership Model for Sustainable Higher Education. *Sustainability* **2022**, *14*, 12279. [CrossRef]
16. Gbobaniyi, G.O.; Srivastava, S. Inclusive Leadership and Academic Loyalty in HEIs. In Proceedings of the GBS InFER Conference, London, UK, 18 November 2022; held at Global Banking School (GBS). Institute For Educational Research (InFER), GEDU House: London, UK, 2022.
17. Chhotray, S.; Sivertsson, O.; Tell, J. The roles of leadership, vision, and empowerment in born global companies. *J. Int. Entrep.* **2018**, *16*, 38–57. [CrossRef]
18. Prewitt, J.; Weil, R. Developing Leadership in Global and Multi-Cultural Organization. *Int. J. Bus. Soc. Sci.* **2011**, *2*, 13–20.

19. Zhang, C.; Ma, L. Research on the Influence of Inclusive Leadership on Employees' Innovative Behaviour. In Proceedings of the 2017 International Conference on Sports, Arts, Education and Management Engineering (SAEME 2017), Taiyuan, China, 29–30 June 2018; Atlantis Press: Amsterdam, The Netherlands, 2017; pp. 124–127.
20. Elegido, J.M. Does it make sense to be a loyal employee? *J. Bus. Ethics* **2013**, *116*, 495–511. [CrossRef]
21. Farrukh, M.; Kalimuthu, R.; Farrukh, S.; Khan, M.S. Role of Job satisfaction and organizational commitment in Employee Loyalty: Empirical Analysis from Saudi Hotel Industry. *Int. J. Bus. Psychol* **2020**, *2*, 1–20.
22. Joshi, A.; Neely, B.H. A structural-emergence model of diversity in teams. *Annu. Rev. Organ. Psychol. Organ. Behav.* **2018**, *5*, 361–385. [CrossRef]
23. Chankseliani, M.; Qoraboyev, I.; Gimranova, D. Higher education contributing to local, national, and global development: New empirical and conceptual insights. *High Educ.* **2021**, *81*, 109–127. [CrossRef]
24. Perales Franco, C.; McCowan, T. Rewiring higher education for the Sustainable Development Goals: The case of the Intercultural University of Veracruz, Mexico. *High Educ.* **2021**, *81*, 69–88. [CrossRef]
25. Rungfamai, K. State, university, and society: Higher educational development and university functions in shaping modern Thailand. *High. Educ.* **2019**, *78*, 149–164. [CrossRef]
26. Owens, T.L. Higher education in the sustainable development goals framework. *Eur. J. Educ.* **2017**, *52*, 414–420. [CrossRef]
27. Ruzek, E.A.; Hafen, C.A.; Allen, J.P.; Gregory, A.; Mikami, A.Y.; Pianta, R.C. How teacher emotional support motivates students: The mediating roles of perceived peer relatedness, autonomy support, and competence. *Learn. Instr.* **2016**, *42*, 95–103. [CrossRef] [PubMed]
28. Granziera, H.; Liem, G.A.D.; Chong, W.H.; Martin, A.J.; Collie, R.J.; Bishop, M.; Tynan, L. The role of teachers' instrumental and emotional support in students' academic buoyancy, engagement, and academic skills: A study of high school and elementary school students in different national contexts. *Learn. Instr.* **2022**, *80*, 101619. [CrossRef]
29. Yano, V.A.N.; Frick, L.T.; Stelko-Pereira, A.C.; Zechi, J.A.M.; Amaral, E.L.; da Cunha, J.M.; Cortez, P.A. Validity evidence for the multidimensional scale of perceived social support at university and safety perception at campus questionnaire. *Int. J. Educ. Res.* **2021**, *107*, 101756. [CrossRef]
30. Bostwick, K.C.P.; Martin, A.J.; Collie, R.J.; Burns, E.C.; Hare, N.; Cox, S.; Flesken, A.; McCarthy, I. Academic buoyancy in high school: A cross-lagged multilevel modeling approach exploring reciprocal effects with perceived school support, motivation, and engagement. *J. Educ. Psychol.* **2022**, *114*, 1931–1949. [CrossRef]
31. Martin, A.J.; Burns, E.C.; Collie, R.J.; Bostwick, K.C.P.; Flesken, A.; McCarthy, I. Growth goal setting in high school: A large-scale study of perceived instructional support, personal background attributes, and engagement outcomes. *J. Educ. Psychol.* **2022**, *114*, 752–771. [CrossRef]
32. Rhoades, L.; Eisenberger, R. Perceived organizational support: A review of the literature. *J. Appl. Psychol.* **2002**, *87*, 698–714. [CrossRef]
33. Blackmur, D. A critical analysis of the UNESCO/OECD guidelines for quality provision of cross-border higher education. *Qual. High. Educ.* **2007**, *13*, 117–130. [CrossRef]
34. Stella, A. Quality assurance of cross-border higher education. *Qual. High. Educ.* **2006**, *12*, 257–276. [CrossRef]
35. Eaggleston, J. Research into Higher Education in England. *High. Educ. Eur.* **1983**, *8*, 66–75. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000057015 (accessed on 26 August 2023). [CrossRef]
36. OECD/European Union. *Inclusive Business Creation: Good Practice Compendium*; Local Economic and Employment Development (LEED); OECD Publishing: Paris, France, 2016. [CrossRef]
37. OECD/European Union. *Supporting Entrepreneurship and Innovation in Higher Education in Ireland*; OECD Skills Studies; OECD Publishing: Paris, France; European Union: Brussels, Belgium, 2017. [CrossRef]
38. OECD/European Union. *Supporting Entrepreneurship and Innovation in Higher Education in Greece*; OECD Skills Studies; OECD Publishing: Paris, France; European Union: Brussels, Belgium, 2021. Available online: https://www.oecd.org/cfe/smes/HEInnovate%20Greece_061221.pdf (accessed on 26 August 2023).
39. Vikki, B.; Christopher, J. England: Tracing Good and Emerging Practices on the Right to Higher Education; Policy Initiatives on the Right to Higher Education in England. UNESCO International Institute for Higher Education in Latin America and the Caribbean. 2023. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000384293 (accessed on 26 August 2023).
40. Meek, V.L.; Teichler, U.; Kearney, M.L. *Higher Education, Research and Innovation: Changing Dynamics*; International Center for Higher Education Research Kassel: Kassel, Germany, 2009. Available online: https://ds.amu.edu.et/xmlui/bitstream/handle/123456789/12934/UNESCO%20Higher%20Education%2C%20Research%20and%20Innovation.pdf?sequence=1&isAllowed=y#page=14 (accessed on 26 August 2023).
41. Carlsen, A.; Holmberg, C.; Neghina, C.; Owusu-Boampong, A. *Closing the Gap: Opportunities for Distance Education to Benefit Adult Learners in Higher Education*; UNESCO Institute for Lifelong Learning: Feldbrunnenstrasse, Germany; Hamburg, Germany, 2016. Available online: https://files.eric.ed.gov/fulltext/ED573634.pdf (accessed on 26 August 2023).
42. UNESCO. Flexible Learning Pathways in British Higher Education. UNESCO IIEP. 2021, pp. 1–14. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000378004 (accessed on 26 August 2023).

43. Brennan, J. Flexible Learning Pathways in British Higher Education: A Decentralised and Market-Based System. Report Prepared within the Framework of the IIEP-UNESCO Research Project 'SDG 4: Planning for Flexible Learning Pathways in Higher Education'. 2021. Available online: https://www.qaa.ac.uk/docs/qaa/about-us/flexible-learning-pathways.pdf (accessed on 26 August 2023).
44. Blau, P.M. A formal theory of differentiation in organizations. *Am. Sociol. Rev.* **1970**, *35*, 201–218. [CrossRef]
45. Eisenberger, R.; Huntington, R.; Hutchison, S.; Sowa, D. Perceived organizational support. *J. Appl. Psychol.* **1986**, *71*, 500–507. [CrossRef]
46. Musselin, C. Are universities specific organizations. In *Towards A Multiversity?: Universities between Global Trends and National Traditions*; Krücken, G., Kosmützky, A., Torka, M., Eds.; Transcript Verlag: Bielefeld, Germany, 2007; pp. 63–84. Available online: https://library.oapen.org/bitstream/handle/20.500.12657/22777/1007385.pdf?sequence=1#page=64 (accessed on 20 July 2023).
47. Davidaviciene, V.; Al Majzoub, K. The Effect of Cultural Intelligence, Conflict, and Transformational Leadership on Decision-Making Processes in Virtual Teams. *Soc. Sci.* **2022**, *11*, 64. [CrossRef]
48. Bagga, S.K.; Gera, S.; Haque, S.N. The mediating role of organizational culture: Transformational leadership and change management in virtual teams. *Asia Pac. Manag. Rev.* **2023**, *28*, 120–131. [CrossRef]
49. Burić, I.; Kim, L.E. Teacher self-efficacy, instructional quality, and student motivational beliefs: An analysis using multilevel structural equation modeling. *Learn. Instr.* **2020**, *66*, 101302. [CrossRef]
50. Kim, G.M.; Kim, Y.; Kim, S.K. Factors influencing the learning transfer of nursing students in a non-face-to-face educational environment during the COVID-19 pandemic in Korea: A cross-sectional study using structural equation modeling. *J. Educ. Eval. Health Prof.* **2023**, *20*, 14. [CrossRef]
51. Hollander, E. *Inclusive Leadership: The Essential Leader-Follower Relationship*; Routledge: England, UK, 2012.
52. Bolden, R.; Petrov, G.; Gosling, J. *Developing Collective Leadership in Higher Education: Final Report for Research and Development Series*; Leadership Foundation for Higher Education (LFHE): London, UK, 2008.
53. Juntrasook, A.; Nairn, K.; Bond, C.; Spronken-Smith, R. Unpacking the narrative of non-positional leadership in academia: Hero and/or victim? *High. Educ. Res. Dev.* **2013**, *32*, 201–213. [CrossRef]
54. Srivastava, S. Job burnout and managerial effectiveness relationship: Moderating effects of locus of control and perceived organizational support: An empirical study on Indian managers. *Asian J. Manag. Res.* **2011**, *2*, 329–347.
55. Matzler, K.; Renzl, B. The relationship between interpersonal trust, employee satisfaction, and employee loyalty. *Total Qual. Manag. Bus. Excell.* **2006**, *17*, 1261–1271. [CrossRef]
56. Dirks, K.T.; Ferrin, D.L. Trust in leadership: Meta-analytic findings and implications for research and practice. *J. Appl. Psychol.* **2002**, *87*, 611. [CrossRef]
57. Eskildsen, J.K.; Nussler, M.L. The managerial drivers of employee satisfaction and loyalty. *Total Qual. Manag.* **2000**, *11*, 581–588. [CrossRef]
58. Bourke, J.; Titus, A. Why Inclusive Leaders are Good for Organizations and how to become one. Diversity and Inclusion. Harvard Business Review. 2019. Available online: https://hbr.org/2019/03/why-inclusive-leaders-are-good-for-organizations-and-how-to-become-one (accessed on 30 January 2023).
59. Veli Korkmaz, A.; van Engen, M.; Schalk, R.; Bauwens, R.; Knappert, L. *INCLEAD: Development of an Inclusive Leadership Measurement Tool*; Tilburg University, Department of Human Resource Studies: Tilburg, The Netherland, 2022. Available online: https://research.tilburguniversity.edu/en/publications/19c2fe2e-eb03-41f3-bd95-5aa12d05cf1a (accessed on 17 March 2023).
60. Alhmoud, A.; Rjoub, H. *Total Rewards and Employee Retention in a Middle Eastern Context*; SAGE Publications: Los Angeles, CA, USA, 2019.
61. Lozano, R.; Lukman, R.; Lozano, F.J.; Huisingh, D.; Lambrechts, W. Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *J. Clean. Prod.* **2013**, *48*, 10–19. [CrossRef]
62. Moed, H.F. A critical comparative analysis of five world university rankings. *Scientometrics* **2017**, *110*, 967–990. [CrossRef]
63. Pietrucha, J. Country-specific determinants of world university rankings. *Scientometrics* **2018**, *114*, 1129–1139. [CrossRef] [PubMed]
64. Allen, N.J.; Grisaffe, D.B. Employee commitment to the organization and customer reactions: Mapping the linkages. *Hum. Resour. Manag. Rev.* **2001**, *11*, 209–236. [CrossRef]
65. Mehta, S.; Singh, T.; Bhakar, S.S.; Sinha, B. Employee loyalty towards organization—A study of academician. *Int. J. Bus. Manag. Econ. Res.* **2010**, *1*, 98–108.
66. Tierney, P. Leadership and employee creativity. In *Handbook of Organizational Creativity*; Zhou, J., Shalley, C.E., Eds.; Lawrence Erlbaum Associates: New York, NY, USA, 2008; pp. 95–123.
67. Liu, N.C.; Cheng, Y. The Academic Ranking of World Universities. *High. Educ. Eur.* **2005**, *30*, 127–136. [CrossRef]
68. McCormack, J.; Propper, C.; Smith, S. Herding cats? Management and university performance. *Econ. J.* **2014**, *124*, 534–564. [CrossRef]
69. Rauhvargers, A. *Global University Rankings and Their Impact: Report II*; European University Association: Brussels, Belgium, 2013.
70. Marconi, G.; Ritze, J. Determinants of international university rankings scores. *Appl. Econ.* **2015**, *47*, 6211–6227. [CrossRef]
71. Kuknor, S.C.; Bhattacharya, S. Inclusive leadership: New age leadership to foster organizational inclusion. *Eur. J. Train. Dev.* 2020; *ahead-of-print*. [CrossRef]
72. Shore, L.M.; Randel, A.E.; Chung, B.G.; Dean, M.A.; Holcombe Ehrhart, K.; Singh, G. Inclusion and diversity in work groups: A review and model for future research. *J. Manag.* **2011**, *37*, 1262–1289. [CrossRef]

73. Washington, M.; Boal, K.; Davis, J. Institutional Leadership: Past, Present, and Future. In *The SAGE Handbook of Organizational Institutionalism*; Greenwood, R., Oliver, C., Suddaby, R., Eds.; SAGE Publications Ltd.: Thousand Oaks, CA, USA, 2008; pp. 721–736.
74. Otaye-Ebede, L. Employees' perception of diversity management practices: Scale development and validation. *Eur. J. Work. Organ. Psychol.* **2018**, *27*, 462–476. [CrossRef]
75. Aboramadan, M.; Dahleez, K.A.; Farao, C. Inclusive leadership and extra-role behaviours in higher education: Does organizational learning mediate the relationship? *Int. J. Educ. Manag.* **2022**, *36*, 397–418.
76. Jyoti, J.; Bhau, S. Empirical investigation of moderating and mediating variables in between transformational leadership and related outcomes: A study of higher education sector in North India. *Int. J. Educ. Manag.* **2016**, *30*, 1123–1149.
77. Ojukwu, M.C. The Effect of Inclusive Leadership and Employee Loyalty: The Mediating Role of Employees' Voice in First Marina Trust Limited, Nigeria. Ph.D. Thesis, National College of Ireland, Dublin, Ireland, 2021.
78. Arici, H.E.; Arasli, H.; Çobanoğlu, C.; Hejraty Namin, B. The effect of favoritism on job embeddedness in the hospitality industry: A mediation study of organizational justice. *Int. J. Hosp. Tour. Adm.* **2021**, *22*, 383–411. [CrossRef]
79. Guo, Y.; Zhu, Y.; Zhang, L. Inclusive leadership, leader identification and employee voice behaviour: The moderating role of power distance. *Curr. Psychol.* **2020**, *41*, 1301–1310. [CrossRef]
80. Javed, B.; Naqvi, S.M.M.R.; Khan, A.K.; Arjoon, S.; Tayyeb, H.H. Impact of inclusive leadership on innovative work behaviour: The role of psychological safety. *J. Manag. Organ.* **2019**, *25*, 117–136. [CrossRef]
81. Yu, M.C.; Mai, Q.; Tsai, S.B.; Dai, Y. An empirical study on the organizational trust, employee-organization relationship, and innovative behaviour from the integrated perspective of social exchange and organizational sustainability. *Sustainability* **2018**, *10*, 864. [CrossRef]
82. Stefani, L.; Blessinger, P. *Inclusive Leadership in Higher Education: International Perspectives and Approaches*; Routledge: New York, NY, USA, 2017.
83. Mitchell, D. Inclusive education is a multi-faceted concept. *Cent. Educ. Policy Stud. J.* **2015**, *5*, 9–30. [CrossRef]
84. Najmaei, A.; Sadeghinejad, Z. Inclusive leadership: A scientometric assessment of an emerging field. *Adv. Ser. Manag.* **2019**, *22*, 221–245.59.
85. Aboki, F.; Pinnock, H. Promoting Inclusive Education Management in Nigeria. EENET. 2021. Available online: https://www.eenet.org.uk/enabling-education-review/enabling-education-review-4/eer-4/4-2/ (accessed on 17 March 2023).
86. Veidemane, A. Education for sustainable development in higher education rankings: Challenges and opportunities for developing internationally comparable indicators. *Sustainability* **2022**, *14*, 5102. [CrossRef]
87. Veidemane, A.; Kaiser, F.; Craciun, D. Inclusive Higher Education Access for Underrepresented Groups: It Matters, But How Can Universities Measure It? *Soc. Incl.* **2021**, *9*, 44–57. [CrossRef]
88. Ashikali, T.; Groeneveld, S.; Kuipers, B. The role of inclusive leadership in supporting an inclusive climate in diverse public sector teams. *Rev. Public Pers. Adm.* **2021**, *41*, 497–519.
89. Mor Barak, M.E.; Luria, G.; Brimhall, K.C. What leaders say versus what they do: Inclusive leadership, policy-practice decoupling, and the anomaly of climate for inclusion. *Group Organ. Manag.* **2022**, *47*, 840–871.
90. Nembhard, I.M.; Edmondson, A.C. Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams. *J. Organ. Behav. Int. J. Ind. Occup. Organ. Psychol. Behav.* **2006**, *27*, 941–966.
91. Korkmaz, A.V.; Van Engen, M.L.; Knappert, L.; Schalk, R. About and beyond leading uniqueness and belongingness: A systematic review of inclusive leadership research. *Hum. Resour. Manag. Rev.* **2022**, 100894.
92. Randel, A.E.; Galvin, B.M.; Shore, L.M.; Ehrhart, K.H.; Chung, B.G.; Dean, M.A.; Kedharnath, U. Inclusive leadership: Realizing positive outcomes through belongingness and being valued for uniqueness. *Hum. Resour. Manag. Rev.* **2018**, *28*, 190–203.
93. Podsakoff, P.M.; MacKenzie, S.B.; Podsakoff, N.P. Sources of method bias in social science research and recommendations on how to control it. *Annu. Rev. Psychol.* **2012**, *63*, 539–569.
94. Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.Y.; Podsakoff, N.P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **2003**, *88*, 879.
95. Alfons, A.; Ateş, N.Y.; Groenen, P.J. A robust bootstrap test for mediation analysis. *Organ. Res. Methods* **2022**, *25*, 591–617.
96. Fagan, H.A.S.; Wells, B.; Guenther, S.; Matkin, G.S. The path to inclusion: A Literature Review of Attributes and Impacts of Inclusive Leaders. *J. Leadersh. Educ.* **2022**, *21*, 88–104. [CrossRef]
97. Aselage, J.; Eisenberger, R. Perceived organizational support and psychological contracts: A theoretical integration. *J. Organ. Behav.* **2009**, *24*, 491–509.
98. Eisenberger, R.; Armeli, S.; Rexwinkel, B.; Lynch, P.D.; Rhoades, L. Reciprocation of perceived organizational support. *J. Appl. Psychol.* **2001**, *86*, 42–51. [PubMed]
99. Kurtessis, J.N.; Eisenberger, R.; Ford, M.T.; Buffardi, L.C.; Stewart, K.A.; Adis, C.S. Perceived organizational support: A meta-analytic evaluation of organizational support theory. *J. Manag.* **2017**, *43*, 1854–1884.
100. Hofmann, D.A.; Morgeson, F.P. Safety-related behaviour as a social exchange: The role of perceived organizational support and leader–member exchange. *J. Appl. Psychol.* **1999**, *84*, 286–296.
101. Garvin, D.A. Building a learning organization. *Harv. Bus. Rev.* **1993**, *71*, 73–91.
102. Confessore, S.J.; Kops, W.J. Self-directed learning and the learning organization: Examining the connection between the individual and the learning environment. *Hum. Resour. Dev. Q.* **1998**, *9*, 365–375. [CrossRef]

103. Jensen, P.E. A contextual theory of learning and the learning organization. *Knowl. Process Manag.* **2005**, *12*, 53–64.
104. Huffman, K.; Vernoy, M.; Williams, B.; Vernoy, J. *Psychology in Action*; John Wiley and Sons: New York, NY, USA, 1991.
105. Kumar, P.C.P.; Prabhakar, P.V. Personality and work motivation: A decisive assessment of Vroom's expectancy theory of employee motivation'. *Asia Pac. J. Res.* **2018**, *1*, 174–179.
106. Rodríguez-Ardura, I.; Meseguer-Artola, A. How to prevent, detect and control common method variance in electronic commerce research. *J. Theor. Appl. Electron. Commer. Res.* **2020**, *15*, 1–5.
107. APA. *Publication Manual of the American Psychological Association*, 7th ed.; American Psychological Association (APA): Washington, DC, USA, 2020. [CrossRef]
108. Hair, J.F.; Sarstedt, M.; Ringle, C.M.; Mena, J.A. An assessment of the use of partial least squares structural equation modeling in marketing research. *J. Acad. Mark. Sci.* **2012**, *40*, 414–433.
109. Williams, L.J.; Hartman, N.; Cavazotte, F. Method variance and marker variables. A review and comprehensive CFA marker technique. *Organ. Res. Methods* **2010**, *13*, 477–514. [CrossRef]
110. Anderson, J.C.; Gerbing, D.W. Structural equation modelling in practice: A review and recommended two-step approach. *Psychol. Bull.* **1988**, *103*, 411–423. [CrossRef]
111. Bollen, K.A. *Structural Equations with Latent Variables*; Wiley: New York, NY, USA, 1989.
112. Medsker, G.J.; Williams, L.J.; Holahan, P.J. A review of current practices for evaluating causal models in organizational behavior and human resources management research. *J. Manag.* **1994**, *20*, 439–464. [CrossRef]
113. Kline, R.B. *Principles and Practice of Structural Equation Modelling*; The Guilford Press: New York, NY, USA, 1998.
114. Hair, E.; Halle, T.; Terry-Humen, E.; Lavelle, B.; Calkins, J. Children's school readiness in the ECLS-K: Predictions to academic, health, and social outcomes in first grade. *Early Child. Res. Q.* **2006**, *21*, 431–454. [CrossRef]
115. Nunnally, J.C. An overview of psychological measurement. In *Clinical Diagnosis of Mental Disorders. Wolman, B.B., Eds.*; Springer: Boston, MA, USA, 1978. [CrossRef]
116. Hooper, D.; Coughlan, J.; Mullen, M. Evaluating model fit: A synthesis of the structural equation modelling literature. In Proceedings of the 7th European Conference on Research Methodology for Business and Management Studies, London, UK, 19–20 June 2008. Available online: https://arrow.tudublin.ie/cgi/viewcontent.cgi?article=1046&context=buschmancon (accessed on 20 July 2023).
117. Hair, J.F.; Anderson, P.E.; Tatham, R.L.; Black, W.C. *Multivariate Data Analysis*; Prentice Hall: Hoboken, NJ, USA, 1998.
118. James, L.R.; Mulaik, S.A.; Brett, J.M. A tale of two methods. *Organ. Res. Methods* **2006**, *9*, 233–244. [CrossRef]
119. Hoyle, R.H.; Smith, G.T. Formulating clinical research hypotheses as structural equation models: A conceptual overview. *J. Consult. Clin. Psychol.* **1994**, *62*, 429–440. [CrossRef] [PubMed]
120. Chang, C.C.; Chiu, C.M.; Chen, C.A. The effect of TQM practices on employee satisfaction and loyalty in government. *Total Qual. Manag.* **2010**, *21*, 1299–1314. [CrossRef]
121. Turkyilmaz, A.; Akman, G.; Ozkan, C.; Pastuszak, Z. Empirical study of public sector employee loyalty and satisfaction. *Ind. Manag. Data Syst.* **2011**, *111*, 675–696. [CrossRef]
122. Abdullah, R.B.; Karim, N.B.; Patah, M.O.R.B.A.; Zahari, H.; Nair, G.K.S.; Jusoff, K. The linkage of employee satisfaction and loyalty in hotel industry in Klang Valley, Malaysia. *Int. J. Bus. Manag.* **2009**, *4*, 152–160. [CrossRef]
123. Kentaro, B. Employee Empowerment, Job Satisfaction and Employee Loyalty: A Case of New Vision Printing and Publishing Company Limited (NYPPCL). Ph.D. Thesis, Makerere University Business School, Kampala, Uganda, 2018. Available online: https://mubsir.mubs.ac.ug/handle/20.500.12282/4634 (accessed on 17 March 2023).
124. Onsardi, A.; Asmawi, M.; Abdullah, T. The effect of compensation, empowerment, and job satisfaction on employee loyalty. *Int. J. Sci. Res. Manag.* **2017**, *5*, 7590–7599.
125. Hanaysha, J.; Tahir, P.R. Examining the effects of employee empowerment, teamwork, and employee training on job satisfaction. *Procedia-Soc. Behav. Sci.* **2016**, *219*, 272–282. [CrossRef]
126. Agarwal, P.; Sajid, S.M. A Study of Job Satisfaction, Organizational Commitment and Turnover Intention among Public and Private Sector Employees. *J. Manag. Res.* **2017**, *17*, 123–136.
127. Auer Antoncic, J.; Antoncic, B. Employee satisfaction, intrapreneurship and firm growth: A model. *Ind. Manag. Data Syst.* **2011**, *111*, 589–607. [CrossRef]
128. Pentareddy, S.; Suganthi, L. Building affective commitment through job characteristics, leadership and empowerment. *J. Manag. Organ.* **2015**, *21*, 307–320. [CrossRef]
129. Chavaha, C.; Lekhawichit, N.; Chienwattanasook, K.; Jermsittiparsert, K. The Moderating Effect of Effective Commitment among the Psychological Empowerment Dimensions and Organizational Performance of Thailand Pharmaceutical Industry. *Syst. Rev. Pharm.* **2020**, *11*, 697–705. Available online: https://www.sysrevpharm.org/articles/the-moderating-effect-of-effective-commitment-among-the-psychological-empowerment-dimensions-and-organizational-performa.pdf (accessed on 26 August 2023).
130. Amaechi, C.V.; Amaechi, E.C.; Oyetunji, A.K.; Kgosiemang, I.M. Scientific Review and Annotated Bibliography of Teaching in Higher Education Academies on Online Learning: Adapting to the COVID-19 Pandemic. *Sustainability* **2022**, *14*, 12006. [CrossRef]
131. Brika, S.K.M.; Chergui, K.; Algamdi, A.; Musa, A.A.; Zouaghi, R. E-Learning Research Trends in Higher Education in Light of COVID-19: A Bibliometric Analysis. *Front Psychol.* **2022**, *12*, 762819. [CrossRef]

132. Amaechi, C.V.; Amaechi, E.C.; Onumonu, U.P.; Kgosiemang, I.M. Systematic Review and Annotated Bibliography on Teaching in Higher Education Academies (HEAs) via Group Learning to Adapt with COVID-19. *Educ. Sci.* **2022**, *12*, 699. [CrossRef]
133. Sweileh, W.M. Global research activity on e-learning in health sciences education: A bibliometric analysis. *Med. Sci. Educ.* **2021**, *31*, 765–775. [CrossRef]
134. Shen, Y.; Huang, L.; Wu, X. Visualization analysis on the research topic and hotspot of online learning by using CiteSpace-Based on the Web of Science core collection (2004–2022). *Front Psychol.* **2022**, *13*, 1059858. [CrossRef]
135. Isa, W.A.R.W.M.; Amin, I.M. A Scientometric Analysis of Twenty Years Trends in Mobile Learning, Blended Learning, Online Learning, E-Learning and Dental Education Research. *Int. J. Acad. Res. Progress. Educ. Dev.* **2022**, *11*, 1019–1029. [CrossRef]
136. Posillico, J.J.; Stanislav, T.A.; Edwards, D.J.; Shelbourn, M. Scholarship of teaching and learning for construction management education amidst the fourth industrial revolution: Recommendations from a scientometric analysis. *IOP Conf. Ser. Earth Environ. Sci.* **2022**, *1101*, 032022. [CrossRef]
137. Obi, L.I.; Omotayo, T.; Ekundayo, D.; Oyetunji, A.K. Enhancing BIM competencies of built environment undergraduates students using a problem-based learning and network analysis approach. *Smart Sustain. Built Environ.* 2022; *ahead-of-print*. [CrossRef]
138. Chatman, J.A.; O'Reilly, C.A. Paradigm lost: Reinvigorating the study of organizational culture. *Res. Organ. Behav.* **2016**, *36*, 199–224. [CrossRef]
139. Naranjo-Valencia, J.C.; Jiménez-Jiménez, D.; Sanz-Valle, R. Studying the links between organizational culture, innovation, and performance in Spanish companies. *Rev. Latinoam. Psicología* **2016**, *48*, 30–41. [CrossRef]
140. Holmbeck, G.N. Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and paediatric psychology literature. *J. Consult. Clin. Psychol.* **1997**, *65*, 599–610. [CrossRef]
141. Haleem, A.; Javaid, M.; Qadri, M.A.; Suman, R. Understanding the role of digital technologies in education: A review. *Sustain. Oper. Comput.* **2022**, *3*, 275–285. [CrossRef]
142. Tripon, C.; Gonța, I.; Bulgac, A. Nurturing Minds and Sustainability: An Exploration of Educational Interactions and Their Impact on Student Well-Being and Assessment in a Sustainable University. *Sustainability* **2023**, *15*, 9349. [CrossRef]
143. Mohiuddin, K.; Nasr, O.A.; Miladi, M.N.; Fatima, H.; Shahwar, S.; Naveed, Q.N. Potentialities and priorities for higher educational development in Saudi Arabia for the next decade: Critical reflections of the vision 2030 framework. *Heliyon* **2023**, *9*, e16368. [CrossRef]
144. Kanu, I.A. Igwebuike as the Hermeneutic of Individuality and Communality in African Ontology. *NAJOP Nasara J. Philos.* **2017**, *2*, 162–179. Available online: https://philarchive.org/archive/IKETDO-3 (accessed on 17 March 2023).
145. Kanu, I.A. Igwebuike as an Igbo-African philosophy of inclusive leadership. *Igwebuike Afr. J. Arts Humanit.* **2017**, *3*, 165–183. Available online: https://www.igwebuikeresearchinstitute.org/journal/3.7.10.pdf (accessed on 17 March 2023).
146. Dyikuk, J.J. The intersection of communication in Igwebuike and trado-rural media: A critical evaluation. *J. Afr. Stud. Sustain. Dev.* **2019**, *2*, 175–192. Available online: https://www.apas.africa/journal/J.2.3.13.pdf (accessed on 17 March 2023).

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Article

Evaluation of the Smart Indonesia Program as a Policy to Improve Equality in Education

Patni Ninghardjanti *, Wiedy Murtini, Aniek Hindrayani and Khresna B. Sangka

Department of the Doctoral Program of Economic Education, Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta 57126, Indonesia; idik_53@yahoo.co.id (W.M.); aniekhindrayani@gmail.com (A.H.); b.sangka@staff.uns.ac.id (K.B.S.)

* Correspondence: ning@staff.uns.ac.id; Tel.: +62-81-2150-2263

Abstract: Inequality of access to education is still a major challenge faced by the Indonesian government and is caused by cost-related issues. Therefore, the government implements the Smart Indonesia Program (SIP) to overcome problems related to costs and increase equitable access to education. The purpose of this study was to evaluate the implementation of the SIP in the Central Java province, Indonesia by examining samples obtained from 20 vocational schools consisting of 1413 students as respondents and 50 informants. The key informant was the school superintendent of the Regional Education Office VII of the Central Java province, which was analyzed with a context, input, process, and product (CIPP) evaluation. The results of this study found that in the sampling area, the implementation of the Smart Indonesia Card (SIC) program was considered to be very good, with an average context point of 82.3% (very good), an input point of 83.4% (very good), a process point of 87.7% (very good), and a product point of 90% (very good). However, two main obstacles that were identified have the potential to affect the effectiveness of (SIC) distribution, including (1) data synchronization between relevant stakeholders and (2) evaluation and reporting systems that did not refer to the principle of accountability. It is concluded that the current scheme does not refer to the principle of accountability.

Keywords: CIPP; human resources; policy evaluation; SIC; vocational education

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1. Introduction

Poverty is still the main challenge faced by the Indonesian government today. In 2017, the population living below the poverty line was calculated as 9.8% or equal to 25.8 million people, resulting in inequality of access in many sectors [1]. When the Asian financial crisis hit the economy badly in 1998, the poverty rate increased to 24.2%. On the other hand, after the economic crisis, poverty decreased from 24.2% in 1998 to 9.4% in 2019. Recent decades of strong economic growth, driven by exports and household consumption, contributed significantly to this achievement [2].

A high poverty rate leads to inequality, whereby inequality burdens equal access, especially to education and health services [3]. The most serious difficulties in poverty alleviation may have occurred when the Indonesian country experienced its first economic downturn in nearly 20 years due to the COVID-19 epidemic [4]. The epidemic resulted in social disruption since millions of people potentially fell into poverty. Therefore, existing poverty alleviation efforts need to be reviewed to compensate for the growing obstacles. From the perspective of education, poverty causes low education attendance in Indonesia. It is known that 8% of the Indonesian population aged 15–24 years fail to complete primary school, 36% of men and 35% of women drop out of school (do not complete their education), and only 16% of Indonesian adults have tertiary education [5]. Indonesia's low educational attainment results in low PISA test scores, which place Indonesia in the 36th position in the world [6]. The government has implemented a number of supporting policies to raise the PISA test score, including producing a national standard test, improving the quality

of education through curriculum development, and conducting yearly regular teacher training [7]. The Indonesian government has implemented a number of measures to reduce poverty, such as a free education program, which will directly increase access to education. However, the program cannot be implemented nationally due to the limited resources of local governments, due to autonomy, so further improvement is required [8]. Furthermore, the government's approach to increasing access to education is to use subsidized programs and direct cash assistance as a form of school assistance. Government assistance was proven to significantly reduce the number of poor people in rural and urban areas by 0.3% per year from 2012 to 2016 [9].

The form of direct school cash assistance provided by the Indonesian government is the Smart Indonesia Program (SIP). The basic concept of the SIP is to provide direct cash assistance to Indonesian students who cannot access elementary school, junior high school, and senior high school to pay for tuition fees and secondary needs such as books and other school supplies [10].

In addition, through the Smart Indonesia Program (SIP), the government launched the Smart Indonesia Card (SIC) under the authorization of the Ministry of Education and Culture (Kemendikbud) through the National Team for the Acceleration of Poverty Reduction. The program aims to help poor students to obtain a proper education, prevent children from dropping out of school, and meet their schooling needs. This assistance is expected to be used by students for fulfilling school needs such as transportation costs for students to go to school, school supplies costs, and pocket money. With the Smart Indonesia Card, it is hoped that there will be no more students dropping out of school due to a lack of funds (see Figure 1). The Indonesia Smart Card (SIC) is given to underprivileged students from elementary school to high school.

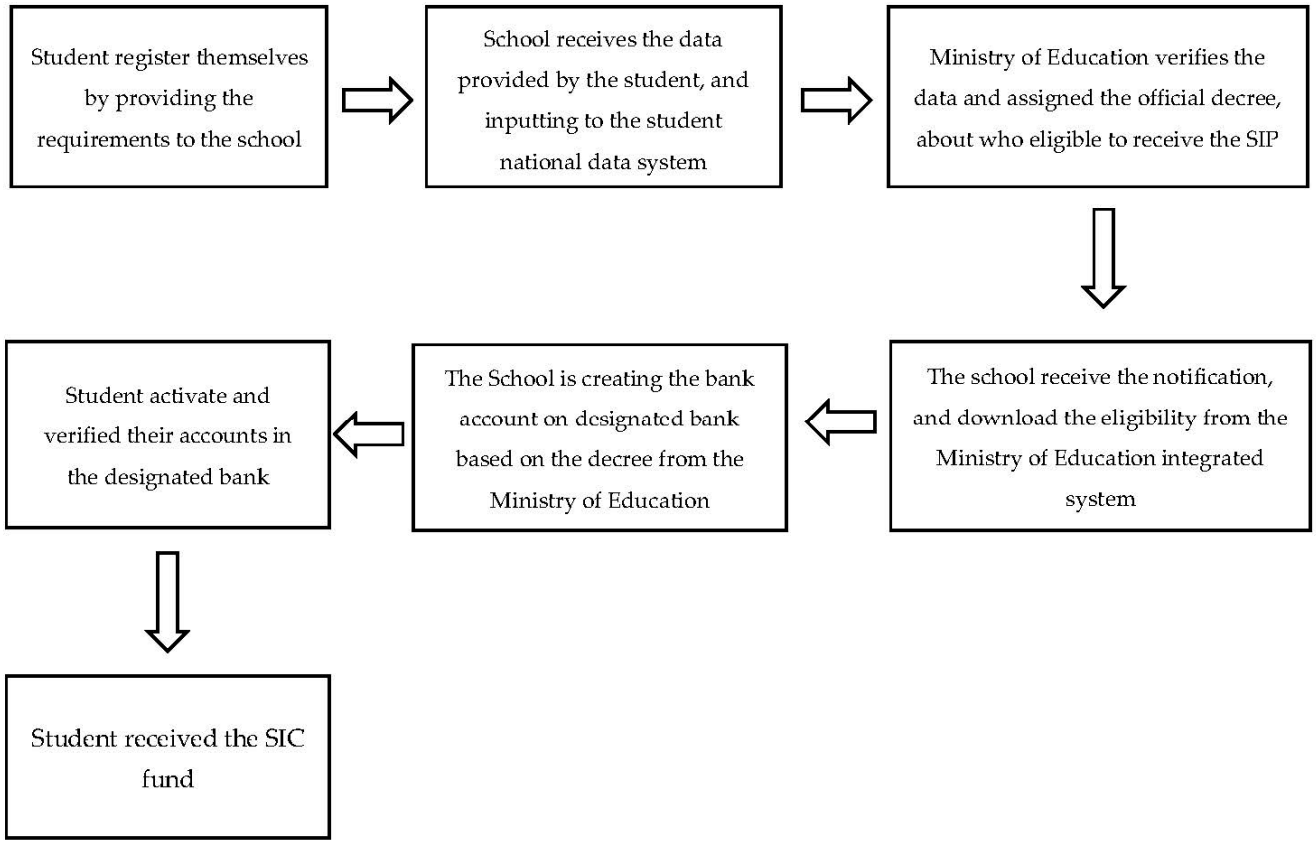

Figure 1. SIC fund disbursement scheme. Note: own elaboration based on [10].

The implementation of the SIP has resulted in a positive impact in several regions, such as Harjamukti Regency. The SIP has been proven to prevent children from dropping

out of school and accommodate the needs of children who have dropped out of school [11]. In the Gorontalo Province, the SIP also shows 90% of the distribution of effective numbers and contributes positively to madrasah attendance rates [12]. Furthermore, in Banyumas Regency, the implementation of the SIP in elementary schools is already on track [13]. Positively, it is undeniable that the SIP has had a positive impact on access to education in several regions in Indonesia.

However, the process of implementing the SIP is also challenging for some regions. In Tasikmalaya Regency, because the SIP lacks the accountability principle, the distribution of funds for the SIP is not properly managed [14]. In Pekanbaru City, the quality of assistance provided by the Smart Indonesia Program is frequently poor due to a lack of coordination, a lack of socialization, and slow payment procedures [15]. Similarly, in the Yogyakarta area, the SIP fails to carry out its role in reducing the dropout rate in Bantul Regency, Yogyakarta, because parents are not fully educated about the SIP [16]. Therefore, several problems in the implementation of the SIP must be identified and analyzed because they can become a burdensome challenge in the national implementation of the SIP.

Based on the analysis above, there are some problems in the implementations of the SIP in several regions in Indonesia. First, there is the problem of targeting and distributing the SIC program. There are two findings that have caused this problem to be evaluated. The distribution of SICs has been considered successful and on target in accordance with the specified criteria [17]. On the other side of these findings, there are several researchers who state that the distribution of SICs is considered unsuccessful, especially regarding targets that are not yet right [18]. This inaccuracy of the targets is caused by processes and bureaucracy that do not run according to procedures, especially regarding the submission of prospective SIC recipients.

Second, there is the issue of the impact of the SIC program. On this issue, there are also two different opinions. Some researchers state that the SIC program has a positive impact on students, such as increased learning motivation, by easing students' concerns about the cost of attending school—which relieves them of the need to work after school, improving academic achievement, because students have more time to study rather than to work after school—and willingness to learn, because the government offers free, high-quality study materials [14,18,19]. Some researchers state that SICs do not have any impact on students in terms of learning unless the existence of SICs provides opportunities for students to take part in the formal education process [18,20–22].

The third issue is about the use of SIC program funds. Based on several findings, the use of SIC funds is said to be appropriate, namely, for education financing [23], but in other findings, the use of SIC funds is not appropriate [24]. Based on these problems, it is necessary to conduct comprehensive research on the evaluation of SIC policies.

If we look at the opinions of experts regarding program evaluation, they say that a series of activities are carried out intentionally to determine the level of success of a program, and this is called program evaluation [25–27]. Program evaluation can also be interpreted as a form of evaluative research, namely, to find out the situation and conditions in an environment [28]. Evaluation is applied in planned or unplanned conditions [29–31]. Program evaluation in several areas is considered very important to optimize the SIC program. In the evaluation of the SIC program, the extent of the success of the SIC program, which aims to improve access to education services, is investigated.

The accuracy of targeting and the correct use of the funds that are received are very important, because the SICs given to participants with the right target characteristics, namely, those coming from poor or vulnerable families, will be able to support the realization of human resources quality. Therefore, the purpose of this study was to identify the main challenges in the SIP implementation, especially in the Central Java province in Indonesia. Conceptually, this study was divided into several steps. First, this study collected data related to the problems that occur in the distribution of SIP funds in the province of Central Java, Indonesia by using questionnaires, in-depth interviews, and observations. Second, the data were analyzed using qualitative analysis, using context, input, process,

and product (CIPP) analysis. Third, after identifying the obstacles at each stage of the SIP implementation using the CIPP method, a new mechanism was developed based on the data. The Central Java province was chosen because it has the highest number of recipients of the SIP, and most of them are vocational school students.

2. Literature Review

To begin, the distinction between sustainability education and sustainable education will be discussed; these are two distinct concepts that are frequently confused, as stated by the authors of [32]. First, the concept of sustainability education refers to either the activities that an educational institution conducts to achieve environmental sustainability or to a study program that contains those agendas, both of which are capable of protecting against environmental crises and creating a "greener" awareness among students, such as through material recycling in the school [32–34]. Sustainable education, on the other hand, refers to the activities that an institution can take to provide a substantial study program [35]. These efforts could include program enhancements and an institutional development strategy. Furthermore, sustainable education refers to a process capable of assuring "financial sustainability" for an educational institution and its activities [32,36].

The Smart Indonesia Program (SIP) is one of the Government of Indonesia's "sustainable education" programs, and it was launched on 3 November 2014. Previously, the government of Indonesia implemented the BOS (School Operational Fund), which was launched in July 2005, to aid schools in Indonesia in their ability to provide learning more optimally. As a result, this program was focused on the needs of the schools, but it was unsuccessful in advancing educational equality because of poor budgeting practices. As a result, many schools continue to charge their students for access to education [37]. Different from the BOS program, the SIP aims to increase access to education services for children aged 6–21 years, including up to 12 years of education or equivalent up to secondary education, and even to higher education, as an effort to prevent students from dropping out of school due to economic limitations and to attract students who have dropped out of school to return to school or attend formal and non-formal educational institutions [38]. The goal is in line with the 1945 Constitution of the Republic of Indonesia Article 31 Paragraph (1), which states that every citizen has the right to education. This is further confirmed in Law Number 20 of 2003 concerning the National Education System Article 1 Paragraph (18), which states that the program is compulsory. Furthermore, education is one of the fundamental rights to which the government is accountable for ensuring access, in accordance with the non-discrimination principle, ensuring that everyone has equal educational rights and is linked to numerous legislative instruments [39].

In Indonesia, the government has implemented the Smart Indonesia Program to facilitate students from poor or pre-prosperous families to receive an education. The program uses Smart Indonesia Cards (SICs), and the distribution of SIC funds is managed using the SIC application (called SIPINTAR). The amount of funds disbursed at each level of education is IDR 450,000 at the elementary level, IDR 750,000 at the junior high level, and IDR 1,000,000 at the senior high or vocational high levels per year. Nationally, the number of recipients of the SIP in Indonesia at all levels of education can be seen in Table 1.

Table 1. Brief description of the SIP recipients at all levels of education.

Year	Elementary School	Junior High School	Senior High School	Vocational High School	Number of Recipients	Poor People
2018	10,379,253	4,598,022	1,479,346	1,953,173	18,409,794	25,950,000
2019	9,485,938	4,236,854	1,306,772	1,653,945	16,262,783	25,140,000
2020	5.050.960	2,187,688	621,616	364,601	8,210,847	26,420,000

Note: own elaboration based on PIP database dashboard [40].

Table 1 shows that there are differences between the SIP recipients and poor people. Furthermore, the majority of SIC recipients are vocational high school students because they are graduates that are ready to work, allowing the government to reap the benefits of assisting poor or pre-prosperous families as soon as possible.

The IDR 500,000 per semester or IDR 1,000,000 per year cash assistance to vocational high school students is expected to increase students' interest in learning and be put to good use by SIC beneficiaries [14]. Unfortunately, in terms of disbursing SICs, there are still beneficiaries who experience problems, including changing mechanisms for receiving assistance, inappropriate use of (cash) funds, and difficulties in collecting evidence of the use of SIC funds.

3. Methods

This research design is evaluation research using qualitative methods with the CIPP model. In this evaluation research, the context, input, process, and product (CIPP) model with qualitative research methods (QRMs) were used. They were applied because they are commonly used by researchers when they want to investigate environments, circumstances, and processes that cannot be studied quantitatively, such as feelings, attitudes, behaviors, and processes [41].

3.1. Method of Collecting Data

The data collection was conducted for 24 months, starting from February 2021 to January 2023. Data collection was carried out in this study using a questionnaire arranged according to a Likert scale, which can be defined as a non-comparative scaling technique applied to an interval scale [42]. The Likert questionnaire category scale in this study is a 5 scale. After collecting the questionnaire data, the triangulation method was conducted to investigate several approaches to comprehending a research problem by performing different data collection methods through observation, interviews, and documentation.

3.2. Determination of Research Location and Respondents

The reason Central Java was chosen for this study is that, in 2020, the vocational school students in this province became the second-highest recipients of SIC funding assistance and were thought to be representative of all national SIC program recipients. In detail, the arrangements are based on the highest number of vocational school students who received the SIC program in the West Java province (376.750 students), Central Java province (338.029 students), and East Java province (265.021 students) [40]. A total of 376.750 students are spread over 1557 vocational schools that are located in the Central Java province. The sample was determined by using the cluster sampling method to divide the population into clusters, such as districts or schools, and then select some of these groups at random as the sample. Then, this research was carried out by involving 20 vocational schools as the sample in the Central Java province (see Table 2).

Snowball sampling was used to obtain 50 respondents for data collection through an interview, and a questionnaire was distributed to 1413 vocational high school students receiving the SIP. The sample used in this research is quite large and diverse and requires segmentation, so snowball sampling is a technique that, first, makes the data source smaller, and then larger, because a small number of data sources does not provide enough data. When the data from one source are still insufficient, the relevant data can be taken from other informants. Interviews and questionnaires were used to carry out the implementation process in stages [43]. Meanwhile, the data's validity was determined through the triangulation of sources and methods, observation, or confirmability. SPSS was used to assess the validity of the questionnaire instrument. The key informant in this study was the principal of the Regional VII Education Office of the Central Java province, while the informants consisted of the principal, counseling guidance teacher/person in charge of SICs, the school SIC admin, as well as students and parents.

Table 2. Sample of the vocational schools.

No	District	Name of the Vocational School
1	Surakarta	SMK Negeri 1 Surakarta
2	Surakarta	SMK Negeri 2 Surakarta
3	Surakarta	SMK Negeri 6 Surakarta
4	Surakarta	SMK Negeri 7 Surakarta
5	Surakarta	SMK Batik 2 Surakarta
6	Wonogiri	SMK Negeri 1 Wonogiri
7	Purbalingga	SMK Negeri 1 Purbalingga
8	Purbalingga	SMK Muhammadiyah Bobotsari
9	Kebumen	SMK Negeri 1 Kebumen
10	Magelang	SMK Muhammadiyah Salaman
11	Jepara	SMK Negeri 1 Pakis Aji Jepara
12	Blora	SMK PGRI Blora
13	Brebes	SMK Negeri 1 Kersana Brebes
14	Batang	SMK Negeri 1 Batang
15	Semarang	SMK Negeri 1 Jambu Semarang
16	Grobogan	SMK Asta Mitra Purwodadi
17	Banyumas	SMK Wijaya Kusuma Jati Lawang
18	Karanganyar	SMKN 1 Karanganyar
19	Sragen	SMKN 1 Sragen
20	Grobogan	SMK At-Thoat Toroh

Note: from author's primary data.

3.3. Data Analysis

The collected data were evaluated using context, input, process, and product (CIPP) analysis, which was developed by Stufflebeam in the 1960s and is considered the most effective evaluation analysis method in the education field [44]. Evaluation research aims to look at the process, achievements, and various information in making the right and correct decisions, as well as to identify obstacles that may arise in each stage of a policy's implementation [45]. CIPP can be described as follows.

3.3.1. Context Evaluation

Context evaluation is the basis of evaluation, the purpose of which is to provide reasons for setting goals. The evaluator's effort in evaluating this context is to provide an overview and details of the environment, needs, and objectives. This context evaluation helps plan decisions, determine the needs to be achieved by a program, and formulate program objectives. Furthermore, in evaluating a policy, a set of rules that direct the study designs and procedures are known as ethical considerations. In research, it is important to respect the principles of voluntary engagement, informed permission, anonymity, secrecy, the possibility of harm, and results communication. Legally, these research ethics are already approved by the Sebelas Maret University, the Teaching and Learning Research Ethics Commission, with approval code 640/UN27.02/PT.01.04/2023, approved on 10 January 2022.

3.3.2. Input Evaluation

Input evaluation aims to provide information about how to use available resources to achieve program objectives. This evaluation includes the identification and assessment of (1) the capabilities of the system used in a program, (2) strategies to achieve program objectives, and (3) the design of the implementation of the chosen strategy.

3.3.3. Process Evaluation

Process evaluation is designed and implemented in the practice of implementing activities, including identifying procedural problems in managing events and activities. Every activity is monitored for changes that occur honestly and carefully. Recording

daily activities is crucial because it is useful for decision-makers to determine follow-up improvements and product evaluation.

3.3.4. Product Evaluation

Product evaluation is the last part of the CIPP model. It aims to measure and interpret program achievements. It shows changes that occur in inputs and provides information on whether a program will be continued, modified, or even discontinued. Each evaluation model must have advantages and disadvantages along with the advantages and disadvantages of evaluating the CIPP model.

4. Results

4.1. Context Evaluation

The context evaluation of this study was evaluated based on how active the schools are in explaining the registration process to the disbursement process to students. The data tabulation of the questionnaire results given by SIC recipients yielded data that were already shown as percentages, which were then used to generate the exposure distribution table shown in Table 3.

Table 3. Percentage of clarity of the registration process to disbursement.

Question Indicator	The Role of Schools in SIC Implementation				
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The registration process to the disbursement process has been explained well by the school to the students	76.9%	18.3%	3.8%	0.6%	0.4%

Based on Table 3, it can be concluded that the majority of students strongly agree that their schools actively informed students about the registration process for disbursement (76.9%). In addition to the questionnaire data, the results of the interviews obtained in the field indicate that schools place more emphasis on their optimal role in the distribution of SIP education funds.

4.2. Input Evaluation

Input evaluation was used to determine the level of concern and activity of the schools in explaining the stages from the registration process to disbursement. Questionnaires were given to 1413 SIC recipients from vocational schools throughout the Central Java province. Based on the data analysis, the opinions of the respondents are shown in Table 4.

Table 4. Percentages of indicators used for input evaluation.

Question Indicator	The Role of Schools in SIC Implementation				
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
SIP funds have been channeled well among poor students	77.4%	14.6%	6.4%	1.3%	03%
Students falsify registration documents during the process	4.7%	1%	0.9%	91.4%	2.0%
The school guides students in the enrollment process	82%	10.7%	5.4%	0.9%	0.12%

Based on Table 4, the answers *strongly agree* and *agree* dominate the results. Most students (77.4%) strongly agree that the funds have been channeled properly among poor students, while 91.4% of students disagree that there is a falsification of documents in the

registration process, and 82% of students strongly agree that the schools guide them during the enrollment process.

Furthermore, for triangulation, in-depth interviews were conducted. Based on the national poverty line standard, 16.21% of the families of SIP recipients had an income of less than IDR 600,000 [46]. The complete data are shown in Table 5.

Table 5. Percentages for incomes of poor families of recipients of SIP.

Respondents Identified	Monthly Family Income	Percentage
229	Less than IDR 600,000–	16.21%
559	IDR 600,000–IDR 1,000,000	39.56%
469	IDR 1,100,000–IDR 2,000,000	33.19%
62	IDR 2,100,000–IDR 2,990,000	4.39%
59	More than IDR 3,000,000,–	4.18%
35	Refused to be interviewed	2.48%

Through interviews with informant 2 who provided information, there were several findings in the field regarding the achievement of the main objectives of the SIC program. The accuracy of the target can be seen from the data collection process for students who received SIC assistance. According to the information obtained from informants 5, 9, and 10, "Most of the SIP recipients have had SIC cards since elementary and junior high school, so when they were in vocational school, these students were called continuous SIC recipients. The data is not updated when entering the next level of education". The detailed information provided by each informant is as follows:

- *Informant 2*: Participants who have disbursed funds must report to the school to be recorded so that they know what the beneficiary disbursed PIP funds are for. However, the main problem is that students and their parents forget to report the disbursement activities to the school, and then the registration process is disrupted, and this affects the data validation.
- *Informant 5*: The decision-making authority varies. The issue is that, regardless of whether there is a ministry, the school is unaware of it; therefore, it is unable to update the data in the context of a recipient's most recent condition.
- *Informant 9*: When entering the vocational school, students who already had KIP cards when they were in elementary or junior high school were referred to as continuous KIP participants. Then the data were not updated when those students entered vocational schools.
- *Informant 10*: Proposing a SIC recipient can be conducted in two ways, namely, 1) by looking at a student's data from the previous level of education (such as junior high school data) that can be accessed at DAPODIK, and 2) if students did not receive SICs when they were in the junior high school, it can be proposed when they enter the vocational high school.

From the information taken from the informants, it can be concluded that the SIC recipient data registration and validation are still not well managed. From one school to another school, there are differences in how the data are gathered and administered.

4.3. Process Evaluation

Process evaluation was used to determine the accuracy of the target, namely, that the respondents who held SICs came from poor families. Table 6 shows the results of the research questionnaire tabulation.

Table 6. Percentages of indicators used for process evaluation.

Question Indicator	The Role of Schools in SIC Implementation				
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
The amount of funds received by students is in accordance with the provisions	85.4%	10.7%	3%	0.6%	0.4%
There is no administration fee during the disbursement process	85.85	10.7%	2.6%	0.5%	0.4%
The school informs students about the disbursement of funds	90.8%	6.5%	1.5%	0.6%	0.6%
The school actively informs students who have not received funds	78%	14%	6%	0.1%	0.1%
Funds are disbursed on time	72.8%	18.9%	6.9%	0.6%	0.7%
The funds are used properly for education-related needs	81.2%	14.8%	3.5%	0.4%	0.1%

The first indicator was whether SIP funds have been channeled properly among poor students. As much as 77.4% of the recipients strongly agreed with the statement. Only 6.4% of recipients said that they did not know for sure, and 1.6% disagreed and strongly disagreed that students who received SIP funds came from poor families. Based on these findings, it can be concluded that the SIP in vocational high schools in Central Java has been well distributed among poor students. The second indicator shows that students also stated that there were no administrative costs, including both school administration and bank management fees. Therefore, all funds in the bank can be disbursed.

The third indicator shows that in the implementation of receiving funds, schools provided information about the stages of the disbursement of SIP assistance funds. It can be seen in the data above that 90.8% of respondents answered *strongly agree* and *agree*. This is also supported by the qualitative data obtained showing that schools periodically look at the information in SIPINTAR to see if there are any new data from the Ministry of Education and Culture. If there is a nomination decree in SIPINTAR, schools immediately notify the students whose names are listed in the decree.

However, the fourth and fifth indicators continue to show some issues. First, the disbursement time cannot be predicted, and second, the school cannot monitor the actual use of funds by SIP recipients due to the difficulty of communicating with the SIC recipients. According to the interviews, several respondents stated that the SIP funds they received were used to purchase electricity pulses and daily necessities.

4.4. Product Evaluation

The SIC products in the form of SIP education funds had been distributed, according to the data received by the committee. Most of the funds are for its designation, namely, for education costs. However, there is no follow-up to the provision of SIC education funds, such as through supervision and monitoring.

The results of the product evaluations obtained that on average, 81.2% of respondents strongly agreed with the impact of this SIC program, showing that the recipients of SIP assistance funds used the funds according to their designation (Table 7). However, some respondents said that part of the SIP assistance fund was used to pay tuition fees, while some respondents from private vocational schools said that they used it to pay tuition fees.

Table 7. Appropriate use of SIP for primary and secondary education funds by students.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
For school-related purposes	81.2%	14.8%	3.5%	0.4%	0.1%
Half of the funds are used for non-school-related purposes	11.0%	13.3%	20.2%	20.5%	35.0%

5. Discussion

The results show that the SIC program was successfully implemented with an average score of 84.7%. It can be concluded that the SIP was increasingly contributing to supporting education for students at the vocational high school level. Based on the results of the analysis that was carried out, several identifications of the strengths of the implementation of the SIP are as follows:

(a) Student participation can be explained by using several indicators, such as the schools guiding students to participate in the SIP (82.0% of respondents answered strongly agree); the role of schools in overseeing the SIC disbursement process (82.0% of respondents answered strongly agree); the schools guiding students in registering for SICs (82.0% of respondents answered strongly agree); the schools notifying students when SICs have been disbursed (90.8% of respondents answered strongly agree); and the schools informing students that they have not taken the SICs in question (78% of respondents answered strongly agree).

(b) The distribution of SIC funds was considered effective and on target, whereby through student participation, it was known that SIC funds had been distributed according to the recipient category, namely, poor families (75.6% answered strongly agree); there was minimum falsification of related documents (91.2% answered disagree for document falsification) in the process of distributing SIP funds; the SIP funds were suitable for school needs (93.8% answered strongly agree and agree); and there were no deductions charged by the channeling banks to students receiving SIP funds (86.3% answered strongly agree).

(c) The SIP supported student facilities and infrastructures for learning, with 55.8% of respondents strongly agreeing that the SIP benefited students' families by facilitating online learning activities.

In addition to the benefits of implementing the SIP in the research area, there were several drawbacks to doing so, which can be summarized as follows:

(a) There was no synchronization of central-level regulations with field-level standard operating procedures (SOPs), from distribution to budget accountability. This was revealed during interviews with several school principals. In addition, the absence of a clear SOP in the reporting of funds that must be carried out by students was a separate obstacle, which reduced the accountability aspect of the use of funds.

(b) Regarding data that had not been integrated, it was identified that the data used in the distribution of SICs were different from those found in the National Education Basis Data (called DAPODIK) and the Ministry of Social Affairs. Through interviews, this was known to affect the efficiency of the SIP distribution, which had the potential to be less targeted.

After analyzing the strengths and weaknesses of the SIP, there are several possible solutions, including the following:

(a) The synchronization of regulations at the central level in the form of official regulations by the Secretariat General of the Ministry of Education and Culture, or related regulations, with the form of the standard operating procedures (SOPs) at the implementing level to reduce administrative malpractices;

(b) The need for a centralized database, which is managed with regular SOPs, to reduce the potential for errors in the distribution of SICs to those who are less entitled, so the SICs can be properly targeted;

(c) The need for special SOPs related to monitoring and evaluating the use of SIP funds so that no maladministration can lead to misuse of the government budget;
(d) There is a need for monitoring related to the use of SIP funds by recipients of the funds that is integrated into the SIPINTAR application by adding student features.

Furthermore, the results of the input evaluation show that the target recipients of SICs were in the very good category at 83.40%. Based on the interviews with related parties, the low value of the target indicator for SIC recipients was because the names of students listed in the decree on the list of SIC recipients were not all the same as those proposed by the schools. According to the principal of a vocational high school, this was due to the less-than-optimal socialization of the SIP. This is supported by previous research. The previous research revealed that several supporting factors were identified as affecting the effectiveness of the Smart Indonesia Card program. However, the most important burden is the little routine socialization in schools for students and parents [23].

In the process evaluation, it was identified that the target accuracy indicator of SIC recipients in the vocational schools who were the respondents for this study was included in the very good category at 87.60%, while the other two indicators were included in the good category. Each indicator had a score of above 80%. One of the reasons based on the results of the interview was that there was no administration fee charged to the beneficiary at the time of the disbursement of funds, so the amount of money received was appropriate without any deductions. In addition, timeliness in distribution was also an additional point that made the distribution process very good. The results of the interviews with students, parents, and schools, as well as the results of the questionnaires, show that there were no deductions by the schools or the banks. The amount of money received by students was IDR 1,000,000 (1 million rupiahs) per year. This type of assistance was quite meaningful for SIC recipients, especially for those who attended private schools because it could be used to pay tuition fees that were in arrears.

The results of the product evaluations show that on average, respondents stated that they strongly agreed with the impact of this SIC program. This research concluded that 90% stated strongly agree, which means that the recipients of SIP assistance funds used the funds according to their designation. However, some respondents said that only part of the SIP assistance fund was used to pay tuition fees, and some respondents from private vocational schools said that they paid tuition fees. Most importantly, the government cannot directly monitor the use of SIP funds because they are evaluated/monitored in schools and because not all SIP fund recipients provided evidence of their use of the funds.

Conceptually, the Smart Indonesia Program through the Smart Indonesia Card was quite clear, including the target recipients. This is because the legal basis for implementing the SIP is coherent, in particular, (1) Presidential Instruction Number 7 in 2014, which contains the mandate of the Smart Indonesia Program to the Ministry of Education and Culture to develop the Smart Indonesia Program, and the Smart Indonesia Cards and the distribution of Smart Indonesia Program funds to students whose parents cannot afford to pay for their education; and (2) the regulation by the Minister of Education and Culture Number 9 in 2018 as an amendment to the regulation by the Minister of Education and Culture Number 19 in 2016 concerning technical guidelines for the Smart Indonesia Program. It can be interpreted that the implementation of SIP financial assistance is feasible to continue.

However, it appeared to be quite problematic at the implementation level, both in terms of the validity and accuracy of the data used as the basis for SICs and how they were distributed. Based on the research that has been carried out, several main problems were identified in the SIC distribution process. The problems were related to the accuracy of the data used to determine potential SIP recipients. Based on interviews conducted involving the SIC admin, the heads of vocational high schools, and other related parties, this problem occurred because the data used came from the registration data for new junior high school students. Many families were able to find poor evidence papers at the time of enrollment for their children to be admitted to public schools. Poor letters from neighborhood coordinators

were discovered to have been used for the National Education Basis Data (called DAPODIK) data, which eventually became invalid, as well as student profiles.

The inaccuracy of the data used in determining prospective SIC recipients ultimately created a sense of injustice in the community and a domino effect. As a result, many underprivileged students did not receive SICs, but students who did not need them, such as graduates or families with capable parents, received SIP funding. Therefore, the inaccuracy of the data used to determine SIP recipients made some of the SIP assistance not on target. As a result, funds that should have been allocated to poor families were not properly channeled, and the government's desire for SIC holders to receive SIP assistance was not fully realized, resulting in not all students from poor families being able to help their families' economic needs in the future. In addition, human resources investment could not be achieved.

Other findings on the constraints in the data collection process are as follows:

(a) Because schools were not involved in determining the target recipients of SIP assistance, schools were extremely vulnerable to data collection errors, which resulted in the inaccurate distribution of SIP funds in the absence of intervention. The solutions proposed to address these issues are as follows: (1) the requirement for initial data input for school DAPODIK. Then, DAPODIK and DTKS (Data Terpadu Kesejahteraan Sosial/Indonesia Integrated Social Welfare Data) synchronization should be performed to improve the intended data integration mechanism to ensure data accuracy. Currently, the data inputted into DAPODIK are junior high school student data, and there is no data updating. As a result, the possibility of incorrect data is high because the economic situations of the parents' families have changed. (2) Improve supervision by involving schools during data verification and validation in targeting SIC recipients so that the mechanism is more transparent and accountable. This can be carried out by making a clear standard operating procedure (SOP) related to the mechanism for submitting data with school involvement in addition to the department's social media to be added to the DTKS data.

(b) There were problems related to the distribution and disbursement of SIP financial assistance. The method and mechanism for distributing SIP funds encountered many obstacles. The time allotted to activate bank accounts was deemed too short, causing many prospective recipients of SIC assistance to forego the account activation process, hampering the distribution of SIC funds. Furthermore, many inactive accounts were discovered for the following year's recipients, causing SIC funds to be held at schools. Based on the interview results, the banks are expected to be able to open a special SIC service counter with a different service scheme than conventional services.

(c) Problems related to the monitoring and evaluation process were also encountered in this study. Many students were late or did not even submit accounting reports on the use of SIC funds to schools, thus disrupting the administration process of the intended distribution. Then, the lack of involvement of several related parties such as the Office of Social Affairs and Education in the financial evaluation of SIC distribution also has a high potential for maladministration, which can later disrupt the SIC reporting process.

According to the findings of the interviews with various parties, the process of uploading proof of data on the use of SIP funds should be carried out by the students themselves, so that data evidence does not accumulate on the desks of school operators who have the potential to commit maladministration. On the other hand, the Indonesian Corruption Watch (ICW) report assessed that the SIC program was ineffective and that many targets were unreliable. Monitoring is carried out to see three aspects, including being right on target, on time, and on disbursement [19]. Based on the report by the ICW, they said that the results of this monitoring show that many (41.9%) of the poor are not registered as SIP participants [47]. This is because the data used for the SIP are still less accurate. Some of the SIP funds were used to finance students' personal needs (personal expenses

and tuition fees/donations to schools). However, most of these funds were not used for educational purposes.

Apart from all the problems and some suggested solutions that have been described, the SIP is good and needs to be continued. Based on the description above, it is emphasized that the implementation of the SIP in vocational high schools, in general, has been carried out well, except in the use of aid funds, which has not yet been monitored due to the difficulty of collecting evidence of use.

Aside from the issues stated above, equal access to education and equity in education remain contentious. These are two distinct concepts that might lead to confusion. Access to education is defined as the stage at which a student can sign up for a program and pay the initial cost. Moreover, equal access to education assumes that there is more than one individual need, determined by objective factors (such as economic conditions, government policy, and gender and race systems) and subjective biographies (such as hard work in school or encouragement to succeed from a family member) [48]. On the other hand, equity in education refers to the quality of an educator, academic standards, curriculum content and methodology, and standardized testing, which all lead to better student outcomes and lower educational inequality [49].

The main equal access to education barrier is economic inequities, which create various groups of people who are radically different from each other, especially in terms of access in various aspects, and the SIP based on the previous discussion is balancing equal access to education by erasing the "economic group" boundaries. Government intervention is very important to improve access, as can be seen in Bangladesh, wherein during the COVID-19 pandemic, it was found that students who live in shacks and tin huts are mostly educated through government initiatives, but those who live in apartments attend private, foreign, and elite public schools. It was concluded that policy involvement by the Bangladeshi government may be the only way to support K-8 (universal) education [50]. On the other hand, equity in education, particularly in terms of teacher quality and infrastructure, in developing countries remains one of the most pressing issues to be addressed, because equal access is deemed insufficient to educate a community, as evidenced by various indicators, such as the PISA score [49]. The next difficulty in establishing the SIP is to create "homogeneous" education that is not just accessible to all students from any social category but also similar in terms of educational quality.

6. Conclusions

After the data analysis process was carried out, the challenges in implementing the Smart Indonesia Program can be explained as follows: (1) The challenges in evaluating context are (a) an incompatibility between regulations at the central and school levels (regulations by the Secretariat General of the Ministry of Education and Culture with standards operational procedures (SOPs) in schools), and (b) a lack of socialization of the related regulations in program implementers, namely, schools. (2) The challenges in evaluating inputs are (a) asynchronous and low-validity data, which cause less-accurate SIC program recipients, SIC recipients who are not right on target, and SIP recipients who do not have SICs. The schools must be involved in student verification and validation to determine which students will receive SIP funding so that it can truly be right on target. (b) There is no clear SOP between the data to be submitted as a database of SIC recipients. (c) The authority of schools is limited to intervening in data so that sometimes the profiles of recipients and the data provided are different. (d) There is a lack of coordination between schools and channeling banks, which has the potential to cause maladministration regarding the amount of funds received. The process is as follows: (a) the bank account of the SIC recipient is blocked, (b) there is no assistance from the bank regarding the problem of receiving SIC funds, whereby SIC recipients must have a special counter or open a counter at school for 1 or 2 days, and (c) there are Class XII KIP recipients who have graduated and have received SIP funding assistance. The challenge in product evaluation is the reporting of funds, which is still constrained by the administrative process because

there is no related SOP. Especially for private schools, many students who receive SIC funds use SIP funds to pay off tuition fees that are in arrears. No significant obstacles were found here. However, it is necessary to pay attention when evaluating and monitoring the use of funds so that it is easy to monitor. Therefore, the SIPINTAR application needs to be equipped with student features to upload proof of the use of funds.

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References

1. Sari, V.A. Poverty and Equity Brief: Indonesia. *Poverty Equity Breief* **2020**, *1*, 1–2.
2. Paksi, R.P. Determinants of Economic Growth: Case of Indonesia. *J. Din. Èkon. Pembang.* **2020**, *3*, 157–171. [CrossRef]
3. Hill, H. What's Happened to Poverty and Inequality in Indonesia over Half a Century? *Asian Dev. Rev.* **2021**, *38*, 68–97. [CrossRef]
4. Suryahadi, A.; Al Izzati, R.; Suryadarma, D. The Impact of COVID-19 Outbreak on Poverty: An Estimation for Indonesia (Draft). *SMERU Work. Pap.* **2020**, *12*, 3–4.
5. OECD. *Indonesia Education at a Glance*; Country Note: Paris, France, 2019.
6. World Population Review Education Rankings by Country 2022. Available online: https://worldpopulationreview.com/country-rankings/education-rankings-by-country (accessed on 6 November 2022).
7. Beatty, A.; Berkhout, E.; Bima, L.; Pradhan, M.; Suryadarma, D. Schooling progress, learning reversal: Indonesia's learning profiles between 2000 and 2014. *Int. J. Educ. Dev.* **2021**, *85*, 102436. [CrossRef]
8. Harapan, I.R.; Tahrun, E. *The Impact of the Free School Program and the Involvement of Parents in School Progress*; Atlantis Press: Amsterdam, The Netherlands, 2021; pp. 488–492. [CrossRef]
9. Adhi, P.N.; Agung, I.G.P.; Gitareja, B. Challenge and Opportunity to Implement the Right to Education for Child Refugees in Indonesia. In *1st International Conference on Law and Human Rights*; Atlantis Press: Amsterdam, The Netherlands, 2020; pp. 54–62. [CrossRef]
10. Ministry of Education and Culture of Republic of Indonesia. *Undang-Undang Nomor 8 Tahun 2020 Tentang Petunjuk Pelaksanaan Program Indonesia Pintar*; Ministry of Education and Culture Republic of Indonesia: Jakarta, Indonesia, 2020; pp. 1–59.
11. Uriyalita, F.; Syahrodi, J.; Anak, P.; Uriyalita, F.; Syahrodi, J. Sumanta evaluasi program indonesia pintar (PIP) telaah tentang aksesibilitas, pencegahan dan penanggulangan anak putus sekolah di wilayah urban fringe harjamukti, cirebon. *Edum J.* **2020**, *3*, 179–199. [CrossRef]
12. Ngiode, S.; Erwinsyah, A. Keefektifan program indonesia pintar di madrasah kabupaten gorontalo. *AL TANZIM J. Manaj. Pendidik. Islam* **2020**, *4*, 48–58. [CrossRef]
13. Mutiara Rakista, P. Implementasi Kebijakan Kartu Indonesia Pintar (PIP) (Studi Kasus pada Sekolah Dasar di Kabupaten Banyumas). *SAWALA* **2020**, *8*, 224–232. [CrossRef]

14. Rohaeni, N.E.; Saryono, O. Implementasi Kebijakan Program Indonesia Pintar (PIP) Melalui Kartu Indonesia Pintar (KIP) dalam Upaya Pemerataan Pendidikan. *J. Educ. Manag. Adm. Rev.* **2018**, *2*, 193–204.
15. Diana, O.; Putri, M. Kualitas Penyaluran Bantuan Dana Program Indonesia Pintar di Kota Pekanbaru. *JOM FISIP* **2018**, *5*, 1–13.
16. Safitri, S.I. *Strategi Kebijakan Pengurangan Angka Drop Out pada Sekolah Menengah Atas (SMA) di Kabupaten Bantul*; Universitas Negeri Yogyakarta: Yogyakarta, Indonesia, 2019.
17. Cahyaningsih, R.I. Pendistribusian Kartu Indonesia Pintar (KIP). *Pedagog. J. Ilmu Pendidik.* **2018**, *18*, 93–99. [CrossRef]
18. Yusuf, B.W.; Ismanto, B. Wasitohadi Evaluasi Program Indonesia Pintar dalam Peningkatan Akses Pendidikan di Sekolah Menengah Pertama. *Kelola J. Manaj. Pendidik.* **2019**, *6*, 44–53.
19. Ahmad, A. Evaluasi Program Indonesia Pintar. *J. Eval. Pembelajaran* **2020**, *2*, 1–18.
20. Herlinawati; Heriyati, E.; Sudiyono; Susanto, A.B. *Strategi Penjangkauan Anak Tidak Sekolah (ATS) Untuk Mengikuti Pendidikan Melalui Program Indonesia Pintar (PIP)*; Kajian Program Indonesia Pintar (PIP): Jakarta, Indonesia, 2018.
21. Sari, R.P. Ahmad Evaluasi Kinerja Program Indonesia Pintar Di Madrasah Ibtidaiyah Swasta Kecamatan Blimbing Kota Malang Dengan Model CIPPO. *J. Eval. Pembelajaran* **2020**, *2*, 1–18. [CrossRef]
22. Zamjani, I. Inklusivitas program indonesia pintar: Studi kasus pelaksanaannya bagi anak berkebutuhan khusus di lima daerah. *J. Pendidik. dan Kebud.* **2019**, *4*, 15–32. [CrossRef]
23. Hamdi, S.; Setiawan, R.; Musyadad, F. Evaluation of the implementation of Indonesia Pintar program in vocational school. *J. Penelit. Eval. Pendidik.* **2020**, *24*, 102–115. [CrossRef]
24. Rijal, M.K.; Fathurrahman, F.; Pranajaya, S.A. Evaluasi program indonesia pintar di madrasah kota balikpapan. *Tarb. Wa Ta'lim J. Penelit. Pendidik. Pembelajaran* **2018**, *5*, 15–33. [CrossRef]
25. Wholey, J.S.; Hatry, H.P.; Newcomer, K.E. *Handbook of Practical Program Evaluation*; John Wiley & Sons, Ltd.: Toronto, CA, USA, 2012; Volume 41.
26. Kellaghan, T.; Stufflebeam, D.L. *International Handbook of Educational Evaluation*; Springer Dordrecht: Dordrecht, The Netherlands, 2014.
27. Cizek, G.J.; Rosenberg, S.L.; Koons, H.H. Sources of Validity Evidence for Educational and Psychological Tests. *Educ. Psychol. Meas.* **2008**, *68*, 397–412. [CrossRef]
28. Wanzer, D.L. What Is Evaluation? Perspectives of How Evaluation Differs (or Not) From Research. *Am. J. Eval.* **2021**, *42*, 28–46. [CrossRef]
29. Hakan, K.; Seval, F. CIPP evaluation model scale: Development, reliability and validity. *Procedia Soc. Behav. Sci.* **2011**, *15*, 592–599. [CrossRef]
30. Mahmudi, I. CIPP: Suatu Model Evaluasi Pendidikan. At-Ta'Dib. *J. At-Ta'dib* **2011**, *6*, 111–125.
31. Lee, S.Y.; Shin, J.-S.; Lee, S.-H. How to execute Context, Input, Process, and Product evaluation model in medical health education. *J. Educ. Eval. Health Prof.* **2019**, *16*, 40. [CrossRef]
32. Alam, G.M. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef] [PubMed]
33. Boca, G.D.; Saraçlı, S. Environmental Education and Student's Perception, for Sustainability. *Sustainability* **2019**, *11*, 1553. [CrossRef]
34. Burmeister, M.; Eilks, I. An understanding of sustainability and education for sustainable development among German student teachers and trainee teachers of chemistry. *Sci. Educ. Int.* **2013**, *24*, 167–194.
35. Sterling, S. Sustainable Education. *Sci. Soc. Sustain.* **2009**, 105–118. [CrossRef]
36. Gedvilaitė, D.; Gudaitis, T.; Lapinskienė, G.; Brazaitis, J.; Žižys, J.; Podviezko, A. Sustainability Literacy and Financial Literacy of Young People in the Baltic States. *Sustainability* **2022**, *14*, 14013. [CrossRef]
37. Kartasasmita, F.P.; Sulistyaningrum, E. The Impact of School Operational Assistance Program Implementation at School Level on Senior Secondary Education Enrollment by Households: Evidence from Indonesia in 2007 and 2014. *Econ. Financ. Indones.* **2021**, *67*, 163–182. [CrossRef]
38. Ministry of Education and Culture of Republic of Indonesia. *Petunjuk Teknis Pelaksanaan Program Indonesia Pintar (PIP) (SIC Program Standard Operation Procedures)*; Kementerian Pendidikan dan Kebudayaan RI: Jakarta, Indonesia, 2015; pp. 11–54.
39. Emmert, S.; Eur, L. Education in Terms of Human Rights. *Procedia Soc. Behav. Sci.* **2011**, *12*, 346–361. [CrossRef]
40. Kemendikbud Data Penyaluran PIP. Available online: https://pip.kemdikbud.go.id/home_v1 (accessed on 12 July 2021).
41. Hazzan, O.; Nutov, L. Teaching and Learning Qualitative Research ≈ Conducting Qualitative Research. *Qual. Rep.* **2014**, *19*, 1–29. [CrossRef]
42. Likert, R. A technique for the measurement of attitudes. *Arch. Psychol.* **1932**, *140*, 55.
43. Nurdiani, N. Teknik Sampling Snowball dalam Penelitian Lapangan. *ComTech Comput. Math. Eng. Appl.* **2014**, *5*, 1110. [CrossRef]
44. AbdiShahshahani, M.; Ehsanpour, S.; Yamani, N.; Kohan, S.; Hamidfar, B. The Evaluation of Reproductive Health PhD Program in Iran: A CIPP Model Approach. *Procedia Soc. Behav. Sci.* **2015**, *197*, 88–97. [CrossRef]
45. Mokhtarzadegan, M.; Amini, M.; Takmil, F.; Adamiat, M.; Sarveravan, P. Inservice trainings for Shiraz University of Medical Sciences employees: Effectiveness assessment by using the CIPP model. *J. Adv. Med. Educ. Prof.* **2015**, *3*, 77–83. [PubMed]
46. Bappeda Litbang Kaltara 14 Kriteria Miskin Menurut Badan Pusat Statistik (BPS). Available online: http://simkesra.kaltaraprov.go.id/web/findikator-kemiskinan (accessed on 18 August 2022).

47. Indonesia Corruption Watch. *Hasil Survey Exclusion Error Program Indonesia Pintar Jokowi-JK (Results of the Jokowi-JK Smart Indonesia Exclusion Error Program Survey)*; Diamond Scientific Publication: Jakarta, Indonesia, 2018.
48. Walker, M. The Achievement of University Access: Conversion Factors, Capabilities and Choices. *Soc. Incl.* **2019**, *7*, 52–60. [CrossRef]
49. Thompson, D.L.; Thompson, S. Educational Equity and Quality in K-12 Schools: Meeting the Needs of All Students. *J. Adv. Educ. Res. Int.* **2018**, *12*, 34–46.
50. Alam, G.M. Access, attendance and performance in urban K8 education during pre- and post-COVID-19 restrictions in Bangladesh: Comparison of students in slums, tin-sheds and flats. *Education* **2022**, *3–13*, 1–18. [CrossRef]

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Exploring University Teacher Construction for Higher Education Sustainability in China: Perspective from Policy Instruments

Guang Ma [1,*], Wanbing Shi [2] and Peng Hou [3]

[1] School of Humanities and Law, Northeastern University, Shenyang 110169, China
[2] Special Education Research Institute, Nanjing Normal University of Special Education, Nanjing 210038, China
[3] College of Life Science and Bioengineering, Shenyang University, Shenyang 110044, China
* Correspondence: 1710010@stu.neu.edu.cn

Abstract: Teacher construction is a long-standing focus of global teacher governance. The construction of a highly qualified and professional higher education teaching force is a source of impetus for the sustainable development of higher education. In-depth systematic analysis of representative macro policies for Chinese university teachers is currently limited. Thus, this study employs the perspective of policy instruments and establishes a two-dimensional analytical framework to examine a key Chinese official teacher policy document to reveal the Chinese government's policy intentions and instrument use preferences for current higher education teacher development. The aim is to explore the improvement of policy instruments for higher education teacher construction to promote sustainable development in China's higher education institutions and to contribute Chinese experience to global teacher governance. The results indicate that the ratio of policy instrument use has structural disparities and insufficient appropriateness to the elements of the teacher management process. Environment-oriented policy instruments have been a critical thrust of the current Chinese government's reform of university teacher development. It is recommended to pay attention to the systemic character of teacher growth and the optimal coordination of content elements and policy instruments to form a governance synergy for the high-quality and sustainable development of higher education.

Keywords: China's university teachers; teacher construction; higher education sustainability; teacher policy; policy instruments

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1. Introduction

In modern, high-speed society, higher education has been contributing multiple resources and solutions for the sustainable development of society. University teachers are the primary implementers of higher education teaching and practice, which are of utmost importance to education, being an extremely critical human resource [1]. The construction state and development direction of university teachers determine the quality of higher education and affect the sustainable development of higher education in China [2]. In other words, university teachers are a core part of the sustainable development of higher education in China. The quality of university teachers is directly related to the orientation and quality of the sustainable development of universities. The teaching force received global attention in teacher governance as early as the 1960s. From its focus on teacher training as a starting point, the World Bank has gone through three periods of initial attention, gradual exploration, and intensive development [3]. The World Bank aims to ensure sustainable global education development by improving the quality of teachers in developing countries, thereby providing a critical boost to their economic growth [4]. It can be seen than the importance of the teacher workforce for economic growth and sustainable educational development is an imperative element in driving global teacher governance. In recent years, with the deepening of China's higher education modernization concept

and strategies, such as building world-class universities, the quality of China's higher education has been improving, and its international influence has been expanding [5]. The sustainable and healthy development of China's higher education plays a positive role in promoting the internationalization and globalization of education [6]. Meanwhile, the sustainable development of China's higher education provides positive support for the excellent global integration of the world pattern. In addition, in the past decade or so, the Communist Party of China (CPC) and the government have attached great importance to higher education and the construction of higher education teachers, promulgated a series of significant strategic policies, and promoted the development of higher education teachers from extensive development to connotative improvement [7]. The continuous increase in the number of higher education teachers, the dramatic improvement in their quality, and the in-depth optimization of their structure have all provided high-quality teachers for the high-quality and sustainable development of higher education in China and provided a strong guarantee of talent and intellectual support for the development of socialism with Chinese characteristics and the internationalization of higher education. According to the 2021 education statistics of China, there were 3012 higher education institutions in 2021, with 44.3 million students in higher education and 1,885,200 full-time teachers in higher education, and the gross enrollment rate of higher education was 57.8%. At this time in China, higher education has wholly entered the era of popularization and generalization. Against such a background, how to promote the prosperity and development of Chinese higher education in a better and sustainable way has become a massive question for the present time. As the internal driving force for the sustainable development of higher education, university teachers are moving in the same direction as the sustainable development of higher education. As close stakeholders in the development, university teachers are critical research subjects for exploring the sustainability of higher education in China as well as globally.

Meanwhile, examining the development of higher education through the lens of education policy has always been a valid entry point in international higher education research [8]. Education policy is part of public policy and has the general characteristics of public policy [9]. As a core part of education policy, teacher policy is a subordinate concept of education policy from the logical perspective of its conceptual definition. Its abstract order with public policy and education policy is: public policy, education policy, and teacher policy [10]. Broadly defined, teacher policy refers to the sum of policies formulated by the government or the political party in power for teachers in a specific period, based on the basic regulations of education, to achieve the goals and tasks of educational development and to solve problems in academic development [11]. As distinct from other public policy, teacher policy is aimed at people with autonomy and motivation. The quality, growth, and development of teachers are the cornerstones of the achievement of teacher policy goals. Teacher policy, as an integral and fundamental policy for the realization of the goals and essentials of education policy, is a powerful method for teacher development reform. The goals and concerns of teacher policies focus on the distribution of power to teachers and the distribution of benefits of teacher resources, which are significant factors affecting the implementation of teacher policies [12]. At the micro level, the reform policy of university teacher construction is to fundamentally solve problems in the education process through policy changes and institutional evolution. At the macro level, the reform policy of higher education teacher construction mainly considers whether it fulfills the development and reform demands through policy governance and provides a source of power for sustainable development. As an initiative to improve the efficiency of internal governance of national universities, the policy of higher education teacher construction provides endogenous power for sustainable development in the process of promoting the improvement of the national governance system and modernization of governance capacity.

In January 2018, the Central Committee of the Communist Party of China (CPC) and the State Council issued the *Opinions on Comprehensively Deepening the Reform of Teacher Construction in the New Era* (*Opinions*).This education policy is the first landmark policy

document issued by the CPC since the founding of China specifically geared toward teacher construction, depicting a grand blueprint for teacher construction in China's new era and sounding a rallying cry to advance the reform of teacher construction [13]. It reflects the fact that building the teaching workforce has become a top priority in China's national agenda [14]. Following the release of the policy, it quickly became a hot topic for scholars at domestic and international levels to study education in China. In December 2020, China's Ministry of Education and six other departments jointly issued the *Guiding Opinions on Strengthening the Reform of College Teacher Construction in the New Era* (*Guiding Opinions*). This policy is the implementation and refinement of the top-level macro education policy of China, pointing out the direction for the reform and development of college teacher construction in the new era, playing an important role in the path of college teacher construction in all regions of China. It also provides an essential leading and guiding role. It offers significant policy guidance for the sustainable development of higher education in China. However, while most of the studies on the development of China's teacher policies have been summarized and interpreted in multiple policy texts, in-depth and systematic analysis of important representative macro policies is rare. The *Guiding Opinions* as a macro top-level policy text of the Chinese government is representative of the development of Chinese higher education teachers and has theoretical and practical significance for in-depth study. Therefore, based on the explicit and authoritative validity of the policy text, this study provides an in-depth examination of the *Guiding Opinions* based on the perspective of policy instruments to better clarify the Chinese government's positioning, policy intentions, and instrumental preferences of university teacher development, which has far-reaching implications for promoting the sustainable development and internationalization of higher education in China and for providing Chinese experiences for global teacher governance.

Thus, this study is divided into the following parts: the first part discusses the selection of policy instruments to examine the importance of the *Guiding Opinions*; the second part elaborates on the sustainable development of education and the research status quo of China's higher teacher team construction; the third part establishes a two-dimensional analysis framework of policy text analysis; the fourth part includes the results and discussion from data analysis; and in the fifth part, conclusions and limitations are given.

2. Perspective of the Theory of Policy Instruments

Policy instruments, also known as governance instruments or government instruments, generally refer to the specific methods and approaches adopted by governments and related authorities to solve practical problems and achieve policy goals [15]. With the expansion of the field of policy science research itself and the tracing of the reasons for policy failures in Western countries, the study of policy instruments has become a focal issue in Western policy science since the 1990s. The enactment and issuance of policies do not represent the implementation of policy goals and policy values. As a link between the policy subject and the policy object, policy instruments play a strategic orientation role in facilitating the practice of the policy object [16]. Choosing the policy instrument needs to consider not only the characteristics of the policy instrument itself, but also the appropriateness of the policy instrument to the policy system. When formulating and implementing policies, rational policy instruments can better fit the policy content and achieve the policy effects, which have an important influence on the policy actors to achieve the intended policy objectives. With the wide application of policy instrument theory in policy science research, an increasing number of scholars have applied a policy instrument approach to the study of education policy. Regarding the research on the theory of policy instruments, there is no consensus in the academic community so far because the classification criteria are different and scholars both at home and abroad have expressed their own views on the classification of policy instruments. In the 1960s, German economist Kirschen was one of the first to attempt to classify policy instruments, focusing on the existence of a range of instruments for implementing economic policy to obtain optimal outcomes. He compiled 64 generalized instruments but did not classify them systematically. McDonell and

Elmore classified the policy instruments into four categories according to the objectives that the policy is intended to obtain, namely, mandate instruments, inducement instruments, capacity-building instruments, and system-changing instruments [17]. Canadian scholars Howlett and Ramesh classified policy instruments into voluntary, mixed, and compulsory instruments based on the degree of government involvement in public services [18]. Based on the goal-oriented character of policy instruments, Schneider and Ingram classified them into five categories: authoritative instruments, motivational instruments, capacity-building instruments, symbolic and exhortation instruments, and learning instruments [19]. Rothwell and Zegveld classified policy instruments into supply, environmental, and demand policy instruments based on the relationship between their effects [20]. When the three types of policy instruments are well-matched and acting together, the policy objectives can be achieved to the utmost extent. The richness and diversity of research on the classification of policy instruments provides multiple perspectives on public policy research. As a product of the integration of policy science theory and practice, policy instruments contribute significantly to the solution and optimization of public problems. Therefore, the perspective of the appropriately selected policy instrument to study the policy text has objective and important research value.

3. Current Status of Research Related to Teacher Construction in China

Since the 1990s, the expression "teacher construction" has frequently appeared in the discourses of Chinese educational and public policy scholars and has received much attention. Scholars have continued to explore and discuss how to improve teacher construction by proposing a series of effective strategies and policy recommendations from a theoretical perspective combined with practical processes. The research on teacher construction ranges from macro to micro, covering different perspectives, regions, stages, institutions, and disciplines, reflecting the richness and diversity of teacher construction research. The representative results include: Wang D. elaborated on the current situation of China's university teacher workforce construction in the new era and pointed out the practical problems in the development of practice [21]; Han J. et al. sorted out and summarized the development trajectory and historical experience of China's university teacher team construction in the past 70 years in new China, which has important insights for teacher workforce construction [22]; Qu T. et al. discussed the history and logical reasoning of the evolution of rural teacher force policy since the founding of new China [23]; Yu F. constructed a three-dimensional analytical framework to quantify the macro-level teacher policy texts at the central level in China [24]; Yang J. et al. conducted an econometric analysis of early childhood teacher workforce construction policies based on a policy instrument perspective [25]; Qi Z. et al. analyzed the preferences for the selection of policy instruments for higher vocational education in China and suggested improvement strategies [26]; Chen Y. et al. conducted a quantitative analysis of policy texts related to China's special education policies of learning in regular classrooms [27]; and Guan Z. analyzed China's education evaluation policy in the new era [28]. As seen above, scholars have discussed the historical evolution of faculty development, existing problems, and analytical methods from different perspectives. The existing results have provided references for this study and ideas for the construction of the analytical framework. However, an in-depth research into the governmental macro policy text *Guiding Opinions* on higher education teacher construction from the perspective of selecting appropriate policy instruments has not been carried out yet. The research needs to be centered on the construction of university teachers, based on the vision of sustainable development of higher education and the ambitious goal of globalization of Chinese higher education.

4. Methods and Theoretical Framework

4.1. Policy Text Selection and Research Methodology

This study selects an important macro policy text collected from Chinese official websites, namely *Guiding Opinions on Strengthening the Reform of College Teacher Construction*

in the New Era (*Guiding Opinions*), which was promulgated by six departments, including the Ministry of Education of China, in December 2020. This policy is the implementation and refinement of national top-level education policy, which indicates the direction for the reform and development of higher education teachers in the new era, playing an important leading and guiding role in all regions of China and providing critical support for the sustainable development of higher education in China. It is a clear reflection of the Chinese government's intention and strategic goal for developing higher education teachers, with substantial research value and authoritative representation.

This study uses textual content analysis (TCA), a scientific research method that analyzes the content of the research object in depth and figures out the essence through the phenomenon, emphasizing the content text, using statistical analysis methods and tools to process the content text [29]. The results are based on qualitative conclusions obtained from the analysis of the data. In this study, the main purpose of the TCA is to provide a statistical and categorical analysis of the content of the policy text.

4.2. Establishing a Two-Dimensional Analysis Framework

4.2.1. X Dimension: Policy Instruments Dimension

Based on the characteristics and properties of the policy text itself and the effects of the application and use of the classification of policy instruments in the academic community, this study uses the ideas of Rothwell and Zegveld and the classification method of policy instruments [20]. This study classifies the policy instruments into supply, environmental, and demand categories. Such policy instruments are more appropriate to the current objectives and orientation of sustainable development of higher education in China and to the study of teacher policies in Chinese higher education institutions. Moreover, they are suitable for the modernized and connotative development of Chinese higher education in the new era, revealing the influence and role of educational governance agents in the reform and development of higher education teaching personnel. Among them, supply-oriented policy instruments can directly push the effective implementation of higher education teacher construction policies by supporting growth, providing resources, and expanding supply; environment-oriented policy instruments can indirectly stimulate the enforcement of higher education teacher construction policies by creating a favorable policy environment; and demand-oriented policy instruments can positively pull the execution effectiveness of higher education teacher construction policies from the level of expanding demand to improve policy performance (Figure 1).

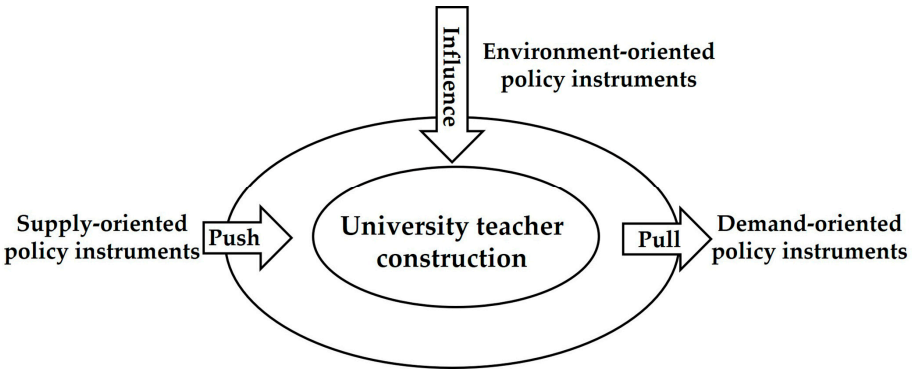

Figure 1. The role of policy instruments in building university teacher construction.

The X dimension is the X axis of the two-dimensional analysis framework. The supply-oriented policy instruments provide an important impetus for the development of university teacher construction, which mainly suggests that the policy subjects offer many resources for the development of university teacher construction through talent training, scientific and technological information support, financial investment, and increasing the building of higher education infrastructure, etc., supplying continuous development boosts

and enhancing the professional attractiveness of university teachers. Environment-oriented policy instruments show that policy subjects provide a strong policy environment for the construction of university teachers by formulating target plans, laws and regulations, financial subsidies, and strategic measures, which have an indirect but not negligible influence. Demand-oriented policy instruments show that policy subjects expand demand through technical service procurement, overseas exchange, and the public–private partnership (PPP) mode, reducing the uncertainty of university teacher construction in the development of the market economy, actively adapting to the education market, and playing a vital role [30].

4.2.2. Y Dimension: The Whole Process Dimension of University Teachers Management

With the emergence of modern human resource management theory, the development of democratic and humane management systems has become a central issue in contemporary management, as the people-centered management model gradually replaced the traditional matter-centered management model. The core of this topic is how to increase human engagement, creativity, and dignity by tapping into human ingenuity, not just leading from the technical function side. The goal is to both increase the productivity of the organization and help people develop to their full potential simultaneously [31]. As the endogenous driving force of sustainable development and the most important strategic human resource in the practice of higher education management, the series of activities of planning, organizing, commanding, controlling, and coordinating their acquisition, development, maintenance, and utilization plays a key role in achieving the strategic goals and sustainable development of higher education. The exploration and management of university teachers' abilities are carried out through the four aspects of introduction, cultivation, application, and maintenance, or the whole process of university teachers' management. Therefore, based on the concept of the entire process of growth and lifelong learning of university teachers and combined with the policy text of the *Guiding Opinions*, this study identifies the Y dimension of the two-dimensional analysis framework, which is the Y axis, as four aspects, namely, attracting talents, cultivating talents, applying talents, and retaining talents. Among them, "attracting talents" refers to promulgating guiding policies to select high-level talents or educators with firm ideal beliefs and excellent professional skills, who have the goal of teaching and educating people to fill the teaching team of colleges and universities; "cultivating talents" refers to continuously strengthening the construction of teachers' moral and instruction style, optimizing the allocation of education and teaching resources, improving the professional quality and ability of college teachers, and enhancing the practical knowledge of college teachers in teaching management; "applying talents" refers to standardizing the assessment and appointment of teachers, deepening the reform of the assessment and evaluation system of college teachers, enhancing the attractiveness and honor of college teachers, highlighting the quality-oriented role of teachers in educating people, and resolutely reversing the tendency of neglect teaching and neglect educating people, etc.; "retaining talents" refers to doing an excellent job in the policy of guaranteeing the development of university teachers' team construction, promoting the reform of the salary system, implementing the income distribution policy oriented to increasing the value of knowledge, making an honor incentive system, title evaluation, distribution incentive mechanism, reasonable flow of talents, and other measures to be targeted in policy implementation.

In summary, this study constructs a two-dimensional analysis framework based on the dual perspectives of policy instruments and the whole process of modern university teachers' management where the X axis is the policy instrument dimension and the Y axis is the whole process dimension of university teachers' management (Figure 2).

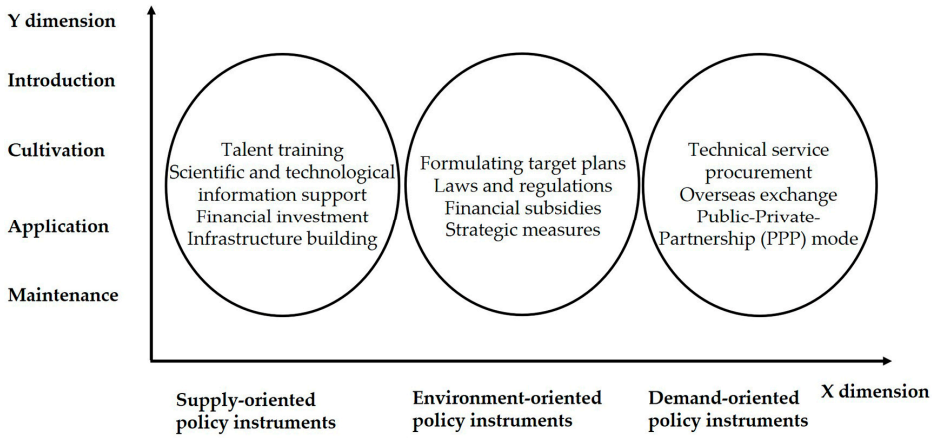

Figure 2. Two-dimensional analysis framework of university teacher construction policy.

4.3. Date Analysis Process

In this paper, the *Guiding Opinions*, after eliminating the introduction, is taken as the primary content analysis unit. The division of appropriate analysis units is crucial for the numerical transformation of policy texts. Based on the repetitive studies and comprehension of the *Guiding Opinions*, the policy text was coded in three paragraphs according to the principle of semantic integrity and inseparability of whole sentences, namely primary paragraph number–secondary paragraph number–single sentence number. It was split into 97 analysis units, which were ultimately formed into a table of analysis of the content of the *Guiding Opinions* (Table 1). Moreover, the 97 units of analysis were matched with the constructed two-dimensional analysis framework, with multiple rounds of discussion and debate to ensure validity, to form a frequency table for the distribution of policy instruments in the X dimension (Table 2) and a frequency table for the distribution of elements of the whole process of university teacher management in the Y dimension (Table 3).

Table 1. The 97 Units for Content Analysis of Policy Texts.

Primary Paragraph	Secondary Paragraph	Single Sentence	Code
Accurately grasp the requirements of the reform time for the construction of the university teaching force and implement the fundamental task of establishing moral education.	Guiding Ideology	Guided by Xi Jinping's thought of socialism with Chinese characteristics in the new era, implement the fundamental task of establishing moral education and focus on the internal development of colleges and universities . . . to serve the national economic and social development to provide a strong guarantee of faculty.	1-1-1
	Target Mission	Through a series of reform initiatives, the university faculty development support system is more complete, the management and evaluation system are more scientific, the treatment guarantee mechanism is more perfect, and the faculty governance system and governance capacity are modernized.	1-2-1
		The professional attractiveness of university teachers has been significantly enhanced, and the ideological and political quality, business ability, education level, and innovation ability of teachers have been significantly improved . . . high quality professional and innovative university teachers.	1-2-2
. . .	. . .	. . .	. . .

Table 1. *Cont.*

Primary Paragraph	Secondary Paragraph	Single Sentence	Code
Strengthen work security to ensure that the policy initiatives are effective on the ground.	Sound Organization and Protection System	The construction of high-quality teachers as the basic work of university construction and the strengthening of the main responsibility of the school . . . collaborative working mechanism.	8-1-1
		Establish a system for leading administrators to contact teachers and listen to their opinions and suggestions regularly.	8-1-2
		. . .	. . . . .
		Strengthen the propaganda of outstanding teachers and typical work and safeguard the legitimate rights and interests of teachers . . . form a good atmosphere of respect for teachers and education in the whole society.	8-1-6

Table 2. Distribution of Policy Instruments in the X Dimension.

Instrument Type	Instrument Name	Code	Number	Percentage
Supply-oriented (27) 27.84%	Talent training	2-1-3, 2-1-4, 2-1-6, 2-2-1, 3-1-1, 3-1-4, 4-1-4, 4-1-7, 4-1-9, 4-5-4, 5-2-3, 7-1-4, 7-1-5, 7-2-4	14	14.43%
	Scientific and technological information support	2-2-7, 2-2-8, 2-3-6, 3-1-2, 3-2-1, 4-4-5, 5-2-2, 6-1-3, 6-2-4, 7-2-3	10	10.31%
	Financial investment	3-2-2, 5-1-2, 5-1-4	3	3.09%
	Infrastructure building	/	0	0
Environment-oriented (59) 60.82%	Formulating target plans	1-1-1, 1-2-2, 2-2-3, 2-3-3, 4-1-2, 4-2-4, 4-3-1, 4-3-3, 4-4-1, 4-4-4, 4-5-1, 4-5-2, 4-5-6, 5-1-1, 5-2-1, 5-2-4, 6-1-1, 6-1-4, 6-2-1, 8-1-1, 8-1-5, 8-1-6	22	22.68%
	Laws and regulations	2-1-5, 2-3-1, 2-3-2, 2-3-4, 4-1-1, 4-1-3, 4-2-2, 6-1-2, 6-1-5, 6-2-3, 7-1-6, 8-1-3, 8-1-4	13	13.41%
	Financial subsidies	5-1-3, 7-2-1, 7-2-2	3	3.09%
	Strategic measures	1-2-1, 2-1-1, 2-1-2, 2-2-2, 2-2-4, 2-2-5, 2-3-5, 3-1-5, 3-2-4, 4-1-5, 4-2-1, 4-2-3, 4-3-2, 4-4-2, 4-4-3, 4-4-6, 4-5-3, 4-5-5, 4-6-2, 6-2-2, 8-1-2	21	21.65%
Demand-oriented (11) 11.34%	Overseas exchange	3-1-3	1	1.03%
	PPP mode	2-2-6, 3-2-3, 4-1-6, 4-6-1, 5-1-5, 7-1-3	6	6.19%
	Technical service procurement	4-1-8, 4-6-3, 7-1-1, 7-1-2	4	4.12%

Table 3. Distribution of Elements of the Whole Process of UTM in the Y Dimension.

Elements	Code	Number	Percentage
Attracting talents	1-1-1, 2-3-1, 2-3-2, 4-1-1, 4-1-2, 4-1-3, 4-1-4, 4-1-6, 4-1-8, 5-1-5, 6-1-1, 6-1-2, 6-1-5, 7-1-1, 7-1-2	15	15.46%
Cultivating talents	1-2-2, 2-1-1, 2-1-5, 2-1-6, 2-2-1, 2-2-3, 2-2-4, 2-3-4, 2-3-5, 2-3-6, 3-1-2, 3-1-3, 3-2-1, 3-2-2, 4-1-5, 6-1-3, 6-2-2, 7-1-3, 7-2-4	19	19.59%
Applying talents	1-2-1, 2-1-2, 2-1-3, 2-1-4, 2-2-2, 2-3-3, 3-1-4, 3-2-3, 3-2-4, 4-1-7, 4-1-9, 4-2-1, 4-2-2, 4-2-3, 4-3-1, 4-3-2, 4-3-3, 4-4-1, 4-4-2, 4-4-3, 4-4-5, 4-4-6, 4-5-4, 4-5-5, 4-6-1, 4-6-2, 4-6-3, 5-2-2, 5-2-3, 6-2-1, 6-2-3, 7-1-4, 7-1-5, 7-1-6, 8-1-1, 8-1-2, 8-1-3, 8-1-5	38	39.18%
Retaining talents	2-2-5, 2-2-6, 2-2-7, 2-2-8, 3-1-1, 3-1-5, 4-2-4, 4-4-4, 4-5-1, 4-5-2, 4-5-3, 4-5-6, 5-1-1, 5-1-2, 5-1-3, 5-1-4, 5-2-1, 5-2-4, 6-1-4, 6-2-4, 7-2-1, 7-2-2, 7-2-3, 8-1-4, 8-1-6	25	25.77%

5. Results and Discussion

5.1. X Dimensional Policy Instruments

According to the statistical results (Figure 3), supply-oriented policy instruments account for 27.84%, environment-oriented policy instruments account for 60.82%, while demand-oriented policy instruments account for 11.34%. Overall, all three types of policy instruments are comprehensively configured and involved. Still, different proportions reflect the Chinese government's preference for the use of policy instruments in the reform and development of university teacher construction in the new era at the national governance level, which shows the government's internal logic and dynamic mechanisms for university teacher construction in the process of promoting sustainable development of education against the background of China's new era.

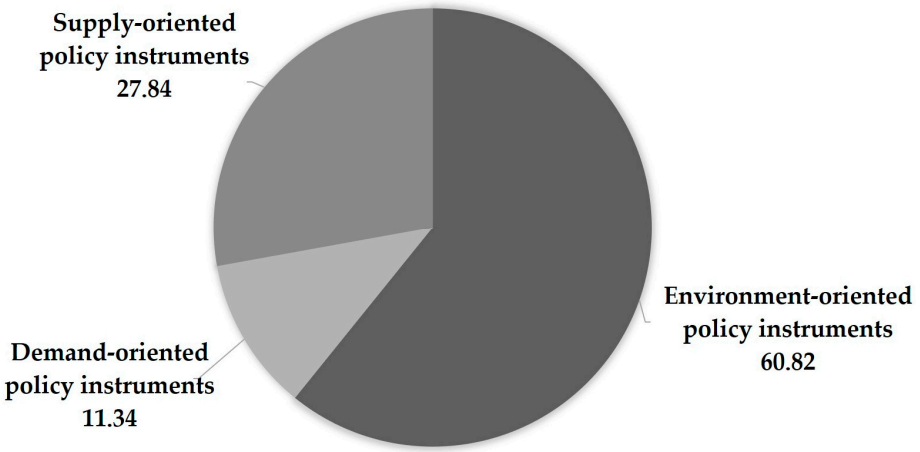

Figure 3. The percentage distribution of policy instruments.

The frequency of supply-oriented policy instruments is 27 times, accounting for 27.84%. Within the supply-oriented policy instruments, the frequency of talent cultivation policy instruments was used 14 times, accounting for 14.43%; the frequency of information support policy instruments was used 10 times, accounting for 10.31%; the frequency of capital

investment policy instruments was used only 3 times, accounting for 3.09%; and the frequency of facility construction policy instruments was used 0 times, accounting for 0. As the leading promoter of sustainable development of higher education, it is especially critical that the personal professionalism of university teachers is appropriate for the development of higher education. As the supply-oriented policy instruments that provide direct impetus, talent cultivation and information support policy instruments are still the most direct and effective power supply. However, there are structural differences in the frequency and proportion of talent development policy instruments and information support policy instruments in the overall use of policy instruments. In the face of the challenges posed by the globalization of technology on talent development, the enhancement of teachers' IT capabilities to cope with teaching and learning is not adequately supported by supply-oriented policy instruments [32]. Against the background of a sustainable and internationalized higher education era, the transmission, change, and interaction of information are becoming more frequent. The communication function of big data information technology has gradually transformed the traditional training mode of university teachers into a diversified and multi-dimensional information education and training method, and the use of policy instruments as a direct driving force should be highly valued. The frequency of using policy instruments for facility construction is 0, which fits with the connotative and sustainable development of Chinese higher education at this stage. In the new era, the construction goal of China's higher education teachers has moved from quantitative increase to qualitative improvement, i.e., the development of teachers has gradually moved from externality to internal content [33]. The external environment and infrastructure construction for teachers' growth have been relatively complete. In China, however, the national financial investment in education as a percentage of national GDP has remained above 4% for 10 consecutive years, making education the top expenditure in the general public budget. The inadequate use of financial investment policy instruments indicates that the current sustainable development of China's higher education teaching force still lacks a stable and comprehensive financial supply, which will have a slowing effect on the distribution of salaries and the promotion of the reform of the remuneration system.

The frequency of use of environment-oriented policy instruments is 59 times, and the ratio of use is 60.82%. The use of environment-oriented policy instruments is considerably higher than supply-oriented policy instruments and demand-oriented policy instruments. This reflects that the Chinese government has created a favorable policy environment to promote the sustainable development of higher education teachers. At the same time, it has taken on the role of a policy service provider and given more autonomy to universities.

Within the environment-oriented policy instruments, 37.29% and 35.59% of the instruments were used for target planning and strategic measures, respectively. The guiding role of target planning and the specific details of strategic measures indicate that the government is eager to accelerate the reform of university teachers' construction through target planning and strategic measures. By laws and regulations, target planning, and strategic measures, the external environment is improved and regulated to create a more positive external environment and indirectly influence the achievement of policy goals.

The demand-oriented policy instruments were used 11 times, accounting for only 11.34%. Among them, the overseas exchange policy instruments, PPP model policy instruments, and service procurement policy instruments account for 1.03%, 6.19%, and 4.12%, respectively, of the overall policy instruments usage percentages. This use shows marginalized characteristics. It indicates that the government is not inclined to resort to pulling demand to stimulate momentum, which still needs to be explored in the search for a fit between demand-based policy instruments and teacher development. The key to gaining advantages and resources in the competition in the knowledge economy lies in the possession and transformation of knowledge, which is essentially the result of teachers' continuous exploration, practice, and long-term accumulation and is the core competitiveness of universities. The demand-oriented policy instruments should play a driving role in the construction of university teachers, maintain the stability of university teachers

in the market, and play a demand-oriented function. The current state of insufficient appropriateness presented may be challenging to stimulate social demand, which is not conducive to pulling up the endogenous power of higher education and playing a delaying influence on the realization of the policy goal of sustainable development of the university teaching team.

5.2. Y Dimensional UTM (University Teacher Management) Whole Process

Examining the policy of *Guiding Opinions* from the whole process of university teachers' management, the frequency of attracting talents involved is 15 times, accounting for 15.46%; the frequency of cultivating talents is 19 times, accounting for 19.59%; the frequency of applying talents is 38 times, accounting for 39.18%; and the frequency of retaining talents is 25 times, accounting for 25.77%. In general, all the stages involved in the management process of university teachers are included, with more comprehensive coverage. Although the proportion is uneven, they all account for more than 10%, reflecting the importance of government agencies on the strategic resource management of talents in the construction of university teachers. The two aspects of attracting talents and cultivating talents reveal a trend of parallel progress. They all take the ideological leadership and teacher moral construction as their primary task. Since the 18th National Congress of the CPC, President Xi Jinping has attached great importance to the construction of teacher morals as the primary task to improve the quality of teachers, develop high-quality education, and provide good education to the satisfaction of the people. The establishment of moral education as the fundamental key to the construction of college teachers fully reflects the educational concept and value of "teachers educate people." In terms of attracting talent, the continuous improvement of the quality of talent cultivated in standard institutes and universities, and the continuous strengthening of professional ability and ideological and political quality have contributed to the advancement of the overall quality of university teachers. The introduction of talent from multiple perspectives to enrich the quantity and quality of higher education teachers is more oriented toward implementing policies. For a long time, the talent cultivation aspect of college teachers has been the focus and concern of higher education work. However, the policy support and inclination toward talent cultivation and talent application and retention have long constituted a weak link. The frequency of talent application and retention is much higher than talent attraction and cultivation, reflecting that in the process of reforming the higher education teachers' team in China, talent application and retention have been highly valued by top-level design and governance institutions, which are also difficult points for the sustainable development of higher education in China in the longer term. In terms of applying talent, the talent management mechanism has been improved and refined from the top design level. In addition to the necessary salary and treatment, the establishment position management has been scientifically optimized, tilting to key disciplines, special disciplines, and important positions. The evaluation and incentive mechanism has been deepened and promoted, and talents are used scientifically and reasonably to give full play to the role of strategic resources and adhere to the correct guidance of talent use. Regarding talent retention, the governing authority accurately grasps Maslow's hierarchy of needs theory. This theory divides human needs into five levels, from low to high: physiological, security, social, respect, and self-actualization. Therefore, for the extraordinary human resources of university teachers, there is not only the motive of seeking material wealth, but also the motive of pursuing non-material wealth [34]. At the same time, it is important for satisfying the basic treatment of talent, scientific research platforms, and other material wealth; for providing corresponding policy support for the demand of non-material wealth of talents; for providing a good academic environment and accelerating their career development; and for stimulating the endogenous motivation for the development of talents of university teachers, which provides important support for the sustainable development of higher education.

5.3. X and Y Dimensional Intersection

Supply-oriented, environment-oriented, and demand-oriented policy instruments are involved in talent attraction, talent cultivation, talent application, and talent retention, which are used comprehensively. There is variability in the use of ratio institutions. Regarding the cultivation of talent, the use of supply-oriented and demand-oriented policy instruments is relatively small, indicating that the influence and supply power in policy implementation is insufficient. Increasing the participation of social forces and overseas exchange is one of the most effective ways to improve the cultivation aspect of teacher construction, as well as to promote the globalization of education and cultural integration. In terms of talent application, environmental policy instruments are sufficiently used, reflecting the need to strengthen the internal and external institutional environment for the sustainable development of higher education teachers in China. In the process of talent application, which requires the use of policy instruments such as laws and regulations, target planning and strategic measures are used to create a good policy implementation environment. Regarding talent attraction, the insufficient use of demand-oriented policy instruments has resulted in a lack of market pull for the construction of higher education teachers, resulting in stability between the attractiveness of the higher education teaching force and the market being affected.

6. Conclusions

China is in the new knowledge economy era of building a country with strong education in all aspects. Promoting the sustainable development of Chinese higher education institutions with the construction and reform of college teachers is the educational mission and strategic goal of university teacher construction and development [35]. The purpose of this study was to explore higher education teacher construction in China through the lens of policy instruments for sustainable development of education and to provide Chinese experiences. The following conclusions were drawn from the analysis. In the use of policy instruments, there is variability in the proportion of policy instruments used. Environment-oriented policy instruments have become the main driving force for government governance to carry out the reform of China's university teachers' construction. Although environmental policy instruments play an indirect influence in the achievement of policy goals, the use of environmental policy instruments plays the main driving role at this stage, which reflects the policy preferences of the Chinese government at this stage. However, the structural differences in the combination of policy instruments are not conducive to the sustainable development of policies and have lagged effects. Chinese educational governance agents should use policy instruments rationally, adjust the structure of policy instruments, and optimize the combination of policy instruments. Each policy instrument has its unique attributes and characteristics and needs to be reasonably structured for use through rational analysis. The logical structure of policy instruments is conducive to giving full play to the advantages of various policy instruments to produce scientific and effective policy effects. Adjusting and optimizing the policy instrument structure of university teachers' construction policy is the key to maximizing the effectiveness of policy instruments, which is also the basis and prerequisite for realizing policy goals.

The whole process of university teachers' management is generally covered, but the structure shows an uneven pattern. There is a lack of relevance in policy instruments and content. The whole process of higher education teachers' management shows a preference for the use of environment-oriented policy instruments and a marginalization of the use of demand-oriented policy instruments, with an overall lack of matching and low synergy. Management is service, which is a requirement for the modernization of national governance capacity [36]. Chinese education policymakers should focus on the whole process of higher education teachers' growth, coordinate all aspects of management, and pay particular attention to the synergistic effectiveness of supply-oriented and demand-oriented policy instruments so as to promote the maximum joint force of internal and external pull, create a favorable education market environment, and achieve the overall

goal of global teacher governance, which is to attract, retain, train, and motivate excellent teachers. It is important to promote the flourishing of higher education with a high-quality teacher workforce, thus achieving comprehensive support for the sustainable development of global education.

This study is exploratory research and has certain limitations. On the one hand, policy instrument theory research is diverse, and so far, there is still no consensus on the selection criteria of policy instrument classification; researchers have started from their own research fields to provide convenient perspectives for theoretical deepening and practical exploration. Although this study selects policy instrument theories based on the characteristics of the time and the needs of social development and carries out a qualitative study with data as indicators, the different policy classification criteria have limitations on the research objects and research conclusions. On the other hand, higher education teacher construction is a complicated and changing social field, which is characterized by changes and expansions, and exploring it from the perspective of policy instruments provides a research perspective on teacher governance and contributes some experiences. Future research will combine multiple perspectives and synthesize changes in the field, balancing quantitative analysis and qualitative research to explore in-depth the path of higher education teacher development in China.

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References

1. Liu, Y.; Tu, M.; Jiang, L. The Practice and Reflection of the School and Local Government Cooperation Training Model for Outstanding Teachers. *Educ. Sci.* **2022**, *38*, 23–29.
2. You, X. The Exploration of the Construction of the World-class Teacher Education System with Chinese Characteristics from the Perspective of China's Teacher Education Policy since the 19th National Congress of the CPC. *Teach. Dev. Res.* **2022**, *6*, 1–7.
3. Mike, Z. The World Bank and Education: Governing (through) Knowledge. *Int. J. Educ. Dev.* **2017**, *53*, 1–11.
4. Yang, P.; Wang, M. Motivation, Strategy and Action Path of World Bank's Participation in Global Teacher Governance. *J. Comp. Educ.* **2022**, *8*, 117–131.
5. Li, J.; Xue, E. A social networking analysis of education policies of creating world-class universities for higher education sustainability. *Sustainability* **2022**, *14*, 10243. [CrossRef]
6. Li, J.; Xue, E. Exploring High-Quality Institutional Internationalization for Higher Education Sustainability in China: Evidence from Stakeholders. *Sustainability* **2022**, *14*, 7572. [CrossRef]
7. Tan, H.; Liu, Y. On Policy Innovation of Teachers Troop Construction: An International Comparative Perspective. *J. North. Norm. Univ.* **2017**, *54*, 111–116.
8. Lin, L.; Wang, S. China's higher education policy change from 211 project and project to the double-first-class plan: Applying kingdon's multiple streams framework. *High. Educ. Policy* **2021**, *35*, 808–832. [CrossRef]
9. Charles, J. *An Introduction to the Study of Public Policy*, 3rd ed.; Brooks/Cole Publishing Company: Wadsworth, OH, USA, 1984; p. 34.
10. Yuan, Z.G. *Education Policy*; Jiangsu Education Press: Nanjing, China, 1996; p. 115.
11. Sandra, T.; Fazal, R.; Bob, L.; Mirian, H. *Educational Policy and the Politics of Change*; Routledge: London, UK, 1997; pp. 2–3.
12. Luan, P.Z. The Way of Policy Development Regarding the Construction of University Teachers under the Perspective of Holistic Governance. *J. Inner Mong. Soc. Sci.* **2021**, *42*, 192–198.
13. Zhang, Y.; Qu, T. A Retrospect and Prospect of the Chinese Communist Party's 100-year Rural Teacher Policies. *Mod. Educ. Manag.* **2021**, *6*, 10–17.
14. Ning, B. Thoughts on Strengthening Teaching Staff Construction of Universities in a New Era. *Chin. High. Educ. Res.* **2018**, *4*, 5–8.

15. Lester, M.S. (Ed.) *The Tools of Government: An Introduction to the New Governance*; Oxford University Press: New York, NY, USA, 2022; pp. 19–21.
16. Yi, H.; Feiock, R.C. Renewable Energy Politics: Policy Typologies, Policy Tools and State Deployment of Renewables. *Policy Stud. J.* **2014**, *42*, 391–415. [CrossRef]
17. Lorraine, M.; Richard, F. Getting the job done: Alternative policy instruments. *Educ. Eval. Policy Anal.* **1987**, *9*, 133–152.
18. Howlett, M.; Ramesh, M. *Studying Public Policy: Policy Cycles and Policy Subsystems*; Oxford University Press: New York, NY, USA, 2003; p. 58.
19. Schneider, A.; Ingram, H. Behavioral assumptions of policy tools. *J. Politics* **1990**, *52*, 510–529. [CrossRef]
20. Rothwell, R.; Zegveld, W. *Reindustrialization and Technology*; Longman Europe Limited: London, UK, 1985; p. 168.
21. Wang, D. The Situation and Tasks of the Construction of Teaching Staff in the New Era. *Educ. Res.* **2018**, *3*, 4–11.
22. Han, J.; Liu, L. Changes, Achievements and Implications of the Policies of College Teacher Construction in 70 Years of New China. *Chin. High. Educ.* **2019**, *17*, 7–9.
23. Qu, T.; Long, Y. The Evolution and Logical Thinking of the Party's Rural Teacher Policy since the Founding of New China. *Teach. Dev. Res.* **2021**, *5*, 8–18.
24. Yu, F. A Quantitative Study on the Policy Texts of Central Level Teachers in the 21st Century: A 3D Analysis Framework. *J. Guangdong Univ. Educ.* **2021**, *4*, 34–49.
25. Yang, J.; Wang, X. A Decade of Action for Kindergarten Teacher Development in the Perspective of Policy Tools. *J. Chin. Soc. Educ.* **2021**, *2*, 88–92.
26. Qi, Z.; Song, Y. Policy Tools for Tertiary Vocational Education in China: Preference for Choice and Strategies for Improvement. *J. Hebei Norm. Univ.* **2022**, *24*, 91–101.
27. Chen, Y.; Zeng, M. A Quantitative Analysis of the Policy Texts Regarding Children with Special Needs Learning in Regular Classrooms in China from the Perspective of Policy Tools. *Chin. J. Special Educ.* **2021**, *9*, 10–18.
28. Guan, Z. Research on China's Educational Evaluation Policy in the New Era from the Perspective of Policy Tools—An Analysis Based on The Overall Plan for Deepening Educational Evaluation Reform in the New Era. *Forum Contemp. Educ.* **2021**, *3*, 32–40.
29. Mikes, M.; Huberman, A. *Qualitative Dada Analysis: An Expanded Source Book*; Sage Publications: Thousand Oaks, CA, USA, 1994.
30. Hao, N.; Guo, Y.; Zhou, Q. A Study on the Policy of Building Teaching Faculty in the New Era of China-Based on Text Analysis of the "Opinions on Deeping the Development and Reform of the Teaching Workforce in the New Era". *Legal Educ. Res.* **2020**, *31*, 339–362.
31. Zhang, C.; Dang, X. *Public Administration Studies*; CRU Press: Beijing, China, 2001; p. 190.
32. Han, X.; Ge, W. Investigating the Chinese College Teachers' Competencies for ICT Integrated into Teaching: A survey Study. *China High. Educ. Res.* **2018**, *7*, 53–59.
33. Qiao, W.; Xing, L. On the Connotation-oriented Development of University. *Educ. Res.* **2009**, *11*, 97–100.
34. Wang, M.; Zhang, Q.; Cheng, L. Changes in China's Graduate Education Reform Policies since Reform and Opening—Based on the Perspective of Word Frequency Statistics Methods and Policy Tools. *Forum Contemp. Educ.* **2020**, *2*, 83–91.
35. Li, J.; Xue, E. Rethinking how to create world-class universities in China: A Policy mapping perspective. *Educ. Philos. Theory* **2022**, *54*, 81–91. [CrossRef]
36. Liu, S. Research on Policy Tools of Higher Education Evaluation Reform in the New Era. *Univ. Educ. Sci.* **2022**, *1*, 81–88.

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Article

Job Burnout amongst University Administrative Staff Members in China—A Perspective on Sustainable Development Goals (SDGs)

Miao Lei [1,2], Gazi Mahabubul Alam [3,*] and Aminuddin bin Hassan [2]

[1] Student Affairs Division, Yancheng Teachers University, Yancheng 224002, China
[2] Faculty of Educational Studies, University Putra Malaysia, Serdang 43400, Selangor, Malaysia
[3] Department of Foundation of Education, Faculty of Educational Studies, University Putra Malaysia, Serdang 43400, Selangor, Malaysia
* Correspondence: gazi.mahabubul@upm.edu.my

Abstract: It is widely accepted that administrative staff, as important components of a university's workforce, play a critical role in realizing the United Nations' Sustainable Development Goals (SDGs). The worth of administrative staff is based on their productivity, and this has a significant impact on the viability of universities. Based on the job demands–resources model, this study investigates the antecedents of job burnout among administrative staff from both emotional and interpersonal perspectives, taking into account SDGs 3, 4, and 8. In this paper, a quantitative research method using descriptive and inferential analyses explores the complex interplay between job autonomy, emotional job demands, colleague support, and job burnout, with a particular emphasis on the role of emotion regulation. A questionnaire was answered anonymously by 1009 administrative staff members in China, and the results conclude that job autonomy was negatively associated with job burnout, while emotional job demands were positively linked to burnout. Moreover, leader support emerged as more beneficial to workers than colleague support. Emotion regulation strategies such as reappraisal function as an important personal resource that buffers the negative effects of job demands and enhances job resources, leading to lower levels of burnout. Furthermore, this study examines how the SDGs can be achieved through reducing job burnout. The important implications for university administrative staff and policymakers, as well as the sustainable development of universities, are discussed.

Keywords: burnout; emotion regulation; SDGs; sustainable education; university administrative staff

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1. Introduction

Research has shown that education has always been an important driving force for sustainable and enlightened economic progress [1], and efforts have been made to implement sustainability at the university level [2]. Several scholars have suggested expanding the scope of sustainable development research in universities not only through research and teaching but also through policy actions, staff participation, and the co-management of the university environment itself [3]. In recent times, studies have discussed the contribution of staff to the sustainable development of universities [4].

It is indeed crucial to understand the workplace environment of university personnel in order to evaluate their ability to help achieve the SDGs, given that universities have certain policies and environmental, personnel, or development goals to adhere to [5]. Although many antecedents (such as individual personality, stress, emotions, and policies) affect the work environment of academic and administrative staff at universities, the significant indicators for staff to evaluate their workplace state are learning opportunities, health status, well-being, and decent employment conditions [6,7].

Generally, the core agenda of the SDGs, such as targets 3, 4, and 8, aim to ensure healthy lives and promote well-being, quality education, and decent work for all, respectively [8].

Although one might expect to find positive correlations between the SDGs and healthy lives, well-being, quality education, and decent work, studies show that job burnout, as an occupational problem (World Health Organization, 2019), has negative associations with personal health, well-being, and decent work [9], Consequently, these negative outcomes of burnout affect the teaching and research processes of academic staff members, while the administrative staff carry out their clerical, bureaucratic, and managerial work properly. Otherwise, the achievement of the United Nations' SDGs is not possible.

In China, higher education has expanded rapidly since 1999 (*China Statistical Yearbook*, various years). This surge in student enrollment, coupled with deteriorating teaching conditions and broad variations in education quality [10], have caused the duties of university staff to be more onerous and challenging. Survey data from Chinese university teachers from 2013 reveal that more than 36% of them experienced increasing pressures [11], with job stress emerging as a critical factor contributing to job burnout [12].

Much of the prior research in higher education has concentrated on academic staff, who primarily engage in teaching and research duties [13]. However, according to the *China Education Statistics Yearbook*, university administrative staff (UAS), who constituted nearly 15% of university staff at the end of 2019, have often been overlooked. Unlike academic staff, the gravity and density of the work of UAS are more intense. Repetitive and tedious work, complex interpersonal relationships, unexpected work content, and limitations due to managerial policies are more likely to cause UAS to work in the "white + black" and "5 + 2" working modes. To be specific, the former means working both days and nights, while the latter means working five days per week (Monday to Friday), with two days off (Saturday and Sunday), implying a seven-day work week. For example, UAS must deal with increasing workloads and novel challenges when providing services and advice to other staff, colleagues, teachers, and students [14]; these factors cause emotional and interpersonal issues since they deal with emotionally charged interactions between coworkers, the working environment, and the work practices themselves. These multifaceted demands contribute to a high incidence of job burnout among UAS.

In addition, job burnout issues should not be ignored. In the higher education context, job burnout has many costs for the university and the staff themselves which are associated with a loss of job satisfaction [15], poor career identity [16], low organizational commitment [17], and poor well-being [18]. These results hinder the development and implementation of SDGs. Hence, the burnout of administrative staff also requires attention in order to improve their well-being, job performance, health status, etc., to promote the implementation of the SDGs.

Based on the job demands–resources model [9], the current study first aims to treat job burnout as an individual symptom [19] in order to investigate how job demands and job resources shape UAS job burnout. Given that individuals' emotional abilities—if they remain at a high level—can help people manage their job demands and communicate well with students, this study hypothesizes that the emotion regulation abilities of UAS can in fact function as a personal resource [20,21]. This study examines whether emotion regulation plays a mediating role between job characteristics and job burnout, and its significance helps us not only to understand the job burnout experienced by UAS but also analyzes what this means for the sustainable development of higher-education institutions and identifies strategies for addressing this issue. The important questions asked herein are as follows:

(1) What is the correlation between colleague support, job autonomy, emotional job demands, emotion regulation strategies, and burnout in UAS?
(2) How does UAS job burnout affect the sustainable workplace conditions in higher education?
(3) Do emotion regulation strategies mediate the correlation between colleague support, job autonomy, emotional job demands, and job burnout?

2. Literature Review

Before exploring the relationship between the variables and job burnout, this literature review first explains the relationship between the SDGs and UAS.

2.1. SDGs and Administrative Staff (UAS)

The United Nations devised the Sustainable Development Goals in 2015 through the 2030 Agenda for Sustainable Development. This document proposes one framework for a 15-year plan aimed at protecting the Earth, empowering people, and ensuring prosperity, peace, and partnership. This ambitious agenda proposes that the sustainable development goals cannot be achieved without everyone's cooperation [22]. It is acknowledged that university staff are important contributors to promoting the sustainable development of higher education [23].

In this increasingly globalized world, universities have the obligation and responsibility to provide quality education to people from all societies because a high-quality education can, in theory, ensure the security, welfare, and prosperity of a nation [24]. University staff play an essential role in realizing these ambitions [25]. This is consistent with SDG 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. However, the cornerstone of a university is a sound administrative system, which determines the success of high-quality research and teaching [26]. Baltaru and Soysal [27] indicate that UAS, who are the personnel that implement the administrative system, play a crucial role in helping universities promote sustainable development through efficient operation and procedures that support academic teachers and students [28].

The question must be asked: what is the workplace environment of UAS? One of the issues affecting the UAS in China is job burnout, which poses a huge challenge to individuals' health and well-being [29]. Studies have shown that job burnout can seriously undermine health, employee well-being, and job performance [19]. This conflicts with SDG 4, which seeks to realize well-being and healthy living for all people of all ages. However, how is it possible to reduce the job burnout of UAS and promote the sustainable development of universities? SDG 8 provides the answer, which aims to create "decent work", enable staff to access a "safe and reliable work environment", and reduce unstable employment [30]. To be specific, decent work is defined as an occupation in which one's duties or tasks are meaningful, the income is reasonable, and the job meets the staff member's expectations [31]. Such conditions lead to increased productivity and high levels of autonomy [32], commitment, job satisfaction, and trust [33]. As stated in SDG 8, this trend is inherently linked to a reduction in job burnout [34,35]. Based on the theme devised for this paper, the sustainable development of universities should focus on addressing job burnout by exploring administrators' emotional and interpersonal experiences.

2.2. A Job Demands-Resources Perspective on Burnout

2.2.1. The JD-R Model

The JD-R model has been extensively applied to interpret job burnout and engagement across different fields [9]. Demerouti et al. [36] devised the JD-R model to understand the factors that lead to burnout. The model divides all job characteristics into two groups: job demands and with job resources. The former means "the organizational, social or physical aspects of work that need sustained physical or mental effort and are thus correlated with psychological and physical costs" [36]. Meanwhile the latter refers to the psychological, physical, organizational, or social aspects of work that may: (a) contribute to the achievement of job goals; (b) reduce job demands and their accompanying psychological and physical costs; and (c) encourage individual growth and progress [36].

In the JD-R model, job demands are typically considered to be the negative organizational, social, or material aspects of a person's job, while job resources are the positive aspects [9]. The JD-R model hypothesizes dual processes that account for the relationship between employee well-being and job characteristics. One process involves damage to

health: high job demands actively predict fatigue associated with workplace tasks, which leads to health and emotional problems [9]. The other process is of a stimulating character: having sufficient resources in place will positively predict motivation or engagement with one's job [9]. Taking into account that job burnout can be the result of two health-damaging conditions, one is the process of exhaustion induced by high job demands and the other is the process of failure to satisfy the demands resulting from insufficient resources [37].

Job burnout is regarded as an outcome of chronic work stress [16] and can occur when short-term stresses are not resolved or dealt with in effective ways. Demerouti et al. [36] indicated that job demands were largely linked to burnout or emotional exhaustion, while job resources were linked to job engagement. Similarly, while shortfalls in job resources can trigger burnout, job resources can, to a certain extent, cushion the role of job demands in triggering burnout [38].

2.2.2. Emotional Job Demands, Job Autonomy, Colleague Support, and Burnout

This work explores the nature of the emotional job demands experienced by Chinese UAS and their correlation with job burnout. Emotional job demands are qualitative workplace issues that are characterized by the variety, intensity, and frequency of the interpersonal interactions required in one's duties [39]. Such demands need continuous individual effort and are linked to some costs [40]. Emotional job demands are generally viewed as harmful and stressful due to the valuable resources they consume and because they can simultaneously cause a person to feel emotionally uncontrollable in many circumstances [41]. In the context of higher education, Yin [42] argued that teachers experience high emotional job demands since they need to constantly manage or regulate their emotions in frequent and intense interactions with students, parents, and colleagues.

Prior studies have indicated that there is close link between serious outcomes and emotional job demands such as job dissatisfaction, burnout, and poor commitment [39]. It has also been observed that emotional job demands are inextricably linked to trait anxiety in employees [43] and work anxiety, as well as emotional exhaustion and health problems [44]. In terms of education, Yin et al. [21] revealed that there is a positive relationship between emotional job demands and the emotional exhaustion felt by academic staff and a negative relationship with job satisfaction and well-being. On this basis, we assumed that emotional job demands would be positively correlated with job burnout among UAS in China, which means that SDGs 3 and 8 cannot be attained. Based on this argument, the following hypothesis is posited:

H1: *Emotional job demands have a positive correlation with job burnout.*

The JD-R model views job autonomy as an essential resource in the workplace [9]. In accordance with this model, job autonomy has a positive impact on the well-being of employees due to the learning opportunities it offers, which benefit SDGs 3 and 4 since employees with greater autonomy have more opportunities to experiment with new ideas and behaviors [45]. This, in turn, can contribute to a variety of positive results, including better job security satisfaction and lower burnout levels [46,47], which is consistent with SDG 8. Conversely, workers with limited autonomy do not have the ability to choose how they respond to the demands placed upon them, leading to a lack of control and an inability to cope with potential stressors [40]. Over time, the draining of an individual's energy due to an inability to cope with job demands can elevate the risk of burnout [36]. With this argument, we put forward this hypothesis:

H2: *Job autonomy has a negative relationship with job burnout.*

Social support is described as the availability of resources, information sharing, and emotional attention from individuals' social networks. Although social support is often deemed to be a single construct in some research studies [48], other research contends that social support may vary in its sources and types. Prior research has identified that job burnout has a negative impact on social support [20]. Moreover, Lim [49] demonstrated

that colleague support can effectively overcome the issues wrought by job insecurity on withdrawal behavior and job satisfaction, which helps to realize SDG 8. In the current work, two types of social support were delineated, specifically, leader support and colleague support, both of which were hypothesized to be negatively correlated with job burnout:

H3: *Leader support (H3a) and colleague support (H3b) are negatively related to job burnout.*

2.3. Emotion Regulation as a Personal Resource

The JD-R model has been refined to include personal resources as an important factor [9]. Personal resources constitute the psychological profile that makes a person able to control and shape their environment [20]. These resources serve as mediators between employee well-being and job demands [9]. Research has demonstrated that the satisfaction of individuals with their basic cognitive needs, for instance, ability, autonomy, and a sense of belonging, plays a mediating role between job demands and fatigue [50].

Emotion regulation is a significant personal resource in the higher education system in that it influences the sense of happiness of teachers/lecturers and the effectiveness of classroom management [51]. Emotion regulation is determined as "the process in which persons affect what emotions they possess, when they possess them, and how they experience and describe such emotions" [52]. Gross presented two extensive emotion regulation strategies, namely, cognitive reappraisal and expressive suppression [53]. Reappraisal is an antecedent-centered emotion regulation strategy that seeks to explain underlying emotional situations in non-emotional terms. Meanwhile, suppression is an emotion regulation strategy based on a response that involves suppressing a person's sustained expression of emotions [53].

Regarding the relationship between burnout and emotion regulation strategies, Gross and John [54] have reported that the persons who applied reappraisal strategies presented with a positive sense of well-being, better interpersonal functioning, and a lower likelihood of having to deal with job burnout issues, which is consistent with SDG 3. Conversely, those who employed suppression strategies exhibited worse interpersonal functioning, a poor sense of well-being, and a better capacity to cope with job burnout, which will hinder the achievement of SDG 3. Similarly, Buruck et al. [55] emphasized that reassessing emotional stimuli is a valid means of handling situations that trigger stress, while suppressing negative emotional behavior is less effective and may have serious outcomes for individuals. In accordance with the former determinations of personal resources, in combination with personal demands or vulnerability factors [9,56], reappraisal should be regarded as a type of personal resource that represents one person's capacity to effectively control their emotions and adapt to their environment. In the meantime, suppression should be considered a personal demand that represents the inability of one person to deal with the emotional demands of the current environment. It is linked to additional effort and psychological or physical costs.

In the education sector, qualitative research conducted by Sutton [57] indicated that successful emotion regulation may reduce susceptibility to burnout. Additionally, quantitative research conducted by Brackett et al. [58] observed that the capacity of teachers to manage their own emotions is positively linked to their positive emotions, personal achievements, and job satisfaction. It is therefore reasonable to assume that the reappraisal strategy and suppression strategy present negative and positive correlations with job burnout, respectively [39]. The most recent empirical research has suggested the negative impact of suppression and the positive effect of reappraisal on the measures of well-being, like job satisfaction, and burnout [21]. Consistent with the above findings, we put forward the following hypothesis:

H4: *Reappraisal (H4a) and suppression (H4b) are negatively and positively linked to job burnout, respectively.*

With reference to the relationships among emotion regulation, job resources, and emotional job demands, Yin et al. [21] contend that cognitive reappraisal is a personal

resource that enables individuals to manage their own emotions and adapt to their environment. Research has shown that teachers use cognitive reappraisals to resolve the effects of emotional job demands on teachers' autonomy in their work [59]. Conversely, suppression is deemed to be a personal demand that reflects a person's inability to deal with emotional job demands, requiring additional cognitive and emotional effort and resulting in physical or psychological strains or costs. Studies suggest that the suppression of emotions exhausts teachers' cognitive resources and is associated with SDGs 4 and 8 due to the poorer quality of their work and their compromised job autonomy [60]. Thus, we assume that:

H5: *Emotional job demands have negative and positive relationships with reappraisal (H5a) and suppression (H5b), respectively.*

H6: *Job autonomy has positive and negative relationships with reappraisal (H6a) and suppression (H6b), respectively.*

The role of support from colleagues as a crucial factor in creating a constructive school environment is one of the factors contributing to achieving SDG 8 [61]. When safety is guaranteed, it is possible that people may feel more comfortable about being themselves [62]. Therefore, trusted colleagues may help ameliorate perceptions of work stress and help to encourage a more relaxed environment that requires fewer coping strategies. Teachers who experience support from colleagues are far more likely to be authentic and use fewer emotion regulation strategies. Conversely, unsupportive colleagues may cause teachers to engage in "surface acting" to fake or cover their true emotions and opinions, while supportive colleagues may facilitate "deep acting" since individuals feel more valued in a genuinely supportive context [63]. According to Grandey's [64] emotion regulation model, emotion regulation at work, or emotional labor, is a central element. It is consequently hypothesized that colleague support has a positive relationship with reappraisal and a negative relationship with the suppression among UAS. Moreover, emotion regulation may mediate the impact of social support on burnout; based on this, two hypotheses are suggested here:

H7: *Leader support has a positive relationship with reappraisal (H7a) and a negative relationship with suppression (H7b).*

H8: *Colleague support has a positive relationship with reappraisal (H8a) and a negative relationship with suppression (H8b).*

Finally, it is hypothesized that emotion regulation may serve as a mediator between emotional job demands, burnout, and job autonomy. We propose the mediated relationship according to the JD-R model, which argues that job demands and job resources may influence burnout through one's personal resource (in this study, emotion regulation). Furthermore, several previous studies have provided evidence to support the mediating role of emotion regulation between job characteristics and work attitudes. For example, Zheng and colleagues [65] revealed that emotion regulation mediated the relationship between job demands and occupational well-being (job satisfaction and emotional exhaustion). Yin and colleagues [21] also uncovered that teachers' emotion regulation strategies mediated the relationships between emotional job demands, trust in colleagues, and teacher well-being. Therefore, in this study, we hypothesize that emotion regulation mediates the relationships among job demands, job resources, and burnout.

3. Methodology

To explore the complex relationships among the job resources, job demands, emotion regulation, and amount of burnout among UAS in the setting of Chinese higher education, the study adopted a quantitative analysis strategy. By collecting self-reported questionnaires, an effort is made herein to reveal the characteristics of the work environment of UAS and the potential antecedents and consequences of workplace characteristics.

3.1. Participants

The relevant data were gathered through an online questionnaire survey in November 2022. In total, 1009 UAS working in 26 universities in 13 cities voluntarily participated in the survey with the permission and assistance of the administrators in charge of UAS in the higher-education institutions in East China, Jiangsu Province. The sample comprised 413 males (40.9%) and 596 females (59.1%), with 229 (22.7%) born after 1995, 317 (31.4%) born between 1990 and 1994, 365 (36.2%) born between 1980 and 1989, 87 (8.6%) born between 1970 and 1979, and 11 (1.1%) born between 1960 and 1969. In total, 115 (11.4%), 859 (85.1%), and 35 (3.5%) respondents had bachelor's, master's, and doctorate qualifications, respectively. Regarding their employment as UAS, 347 (34.4%) had worked for 3 years or less, 251 (24.9%) had worked for 4 to 7 years, 233 (23.1%) had for 8 to 15 years, 138 (13.7%) had worked for 16 to 23 years, and 40 (40.0%) had worked for a minimum of 24 years. Concerning the institutions at which the UAS worked, 292 (28.9%) were affiliated with Double First Class universities, 539 (53.4%) with general undergraduate universities, and 178 (17.6%) with higher vocational colleges. Regarding their average working hours per day, 6 (0.6%) worked less than 3 h, 20 (20.0%) worked 3–6 h, 145 (14.4%) worked 6–8 h, and 838 (83.1%) worked more than 8 h. Regarding their time spent with students per day, 66 (6.5%) spent less than 1 h, 181(17.9%) spent 1–2 h, 227 (22.5%) spent 3–4 h, 141(14.0%) spent 4–5 h, 83 (8.2%) spent 5–6 h and 311 (30.80%) spent more than 6 h with students.

3.2. Instruments

3.2.1. Emotional Job Demands

The Emotional Job Demands Scale (EJDS) [42] served to examine the job demands of the UAS. This scale consists of four items that primarily evaluated the views of the UAS on the emotional demands of their jobs. One example of such an item is: "In order to do my job well, I have to spend a lot of time with colleagues and students." Participants scored each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's alpha (α) amounted to 0.92, meaning that there was an acceptable internal consistency.

3.2.2. Emotion Regulation Strategies

The Emotion Regulation Questionnaire (ERQ) [54] was utilized to investigate the use of emotion regulation strategies by the UAS. Six items were evaluated for reappraisal, for instance: "I will change may way of thinking when I want to feel more positive emotions at work," and four items were evaluated for suppression, such as, "At work, I control my emotions by inhibiting and not expressing them". Participants scored each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The alpha coefficients were 0.89 and 0.78 for the reappraisal and suppression scales, respectively, highlighting an acceptable internal consistency.

3.2.3. Burnout

The five items of the Maslach Burnout Inventory—General Survey (MBI) [66] served to examine the university administrative staff members' job burnout. Examples of the items were as follows: "Work makes me feel like I'm falling apart", and "Work makes me feel physically and emotionally drained." Participants scored each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's alpha (α) of the scale was 0.93, revealing a sound internal consistency.

3.2.4. Job Resources

The Job Resources Scales (JRS) selected three types of job resources. Three items assessed job autonomy (for example: "I have a say in what happens at work."), four items assessed leader support (for instance, "My supervisor cares about the well-being of the employees in the department."), and four items evaluated colleague support (e.g., "My colleagues care about me."). All these scales were adapted from a Chinese version of the Job

Content Questionnaire [67]. Participants scored each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The alpha coefficients were 0.87, 0.92, and 0.86 for the job autonomy, leader support, and colleague support scales, respectively, indicating an acceptable internal consistency.

3.3. Analysis

The analysis was executed utilizing SPSS 21.0 and Mplus 8.0. The correlations and descriptive statistics were calculated via SPSS, while Mplus provided structural equation modeling (SEM). SEM functioned to explore the associations among the constructs of interest. Unobservable potential constructs that were defined via one or more observed variables were assessed using SEM, which simultaneously modelled all parameters. A confirmatory factor analysis (CFA) tested the structural validity of the scales. In the meantime, an evaluation of model fit was carried out via the root mean square error of approximation (RMSEA), Chi-square value (χ^2), comparative fit index (CFI) and the Tucker–Lewis Index (TLI). When the TLI and CFI are not under 0.90 (higher is better), the data fit is acceptable, and an acceptable fit requires an RMSEA value of less than 0.10 (lower is better) [68]. A bootstrap method was exploited to determine the indirect effects of the mediation analysis [69].

4. Results

4.1. Descriptive Result

Table 1 displays the descriptive statistics data, reliability, and correlations. The CFA showed a good data fit for the Emotional Job Demands Scale (χ^2 = 22.71, df = 2, $p < 0.01$, RMSEA = 0.10; CFI = 0.993; TLI = 0.979), Maslach Burnout Inventory (χ^2 = 80.98, df = 5, $p < 0.01$, RMSEA = 0.10; CFI = 0.96, TLI = 0.92), Job Resources Scale (χ^2 = 134.11, df = 32, $p < 0.01$, RMSEA = 0.06; CFI = 0.99; TLI = 0.98), and the Emotion Regulation Questionnaire (χ^2 = 454.31, df = 34, $p < 0.01$, RMSEA = 0.10, CFI = 0.92, TLI = 0.90). These scales all demonstrated excellent reliability and structural validity. Table 1 summarizes that UAS have the highest scores in terms of emotional job demands (M = 4.10; SD = 0.68), and the lowest scores in terms of job burnout (M = 3.22; SD = 0.97) and job autonomy (M = 3.21; SD = 0.89). For correlations, all variables were remarkably correlated, even including an insignificant correlation between emotional job demands and job autonomy ($p < 0.01$). The correlation coefficients lie between −0.28 and 0.63, and in fact, all were less than 0.70. The job autonomy, leader support, colleague support, and emotion reappraisal of these staff members are all negatively correlated with job burnout.

Table 1. Descriptive statistics, reliability, and correlations matrix.

Factors	1	2	3	4	5	6	7
1. JAD	—						
2. EJD	0.03	—					
3. LS	0.44 **	0.10 **	—				
4. COS	0.35 **	0.22 **	0.63 **	—			
5. SU	0.10 **	0.27 **	0.18 **	0.19 **	—		
6. RE	0.22 **	0.50 **	0.31 **	0.35 **	0.61 **	—	
7. JB	−0.28 **	0.21 **	−0.28 **	−0.19 **	0.14 **	−0.03	—
Cronbachα	0.87	0.92	0.92	0.86	0.78	0.89	0.93
M	3.21	4.10	3.60	3.88	3.42	3.83	3.22
SD	0.89	0.68	0.93	0.71	0.71	0.59	0.97

Note: JAD = job autonomy; EJD = emotional job demands; LS = leader support; COS = colleague support; SU = suppression; RE = reappraisal; JB = job burnout. ** $p < 0.01$.

4.2. SEM Results

To explore the complex relationships among job resources, job demands, emotion regulation strategies, and burnout, an SEM analysis was conducted, and the results are

displayed in Figure 1. The results revealed an excellent model fit (χ^2 = 1966.01, df = 357, p = 0.00, RMSEA = 0.067, CFI = 0.92, TLI = 0.91). Emotional job demands can positively predict job burnout (β = 0.29, $p < 0.01$), reappraisal (β = 0.51, $p < 0.01$), and suppression (β = 0.33, $p < 0.01$); therefore, H1 and H5b are supported. Job autonomy has a negative relationship with burnout (β = −0.17, $p < 0.01$) but a positive relationship with reappraisal (β = 0.10, $p < 0.01$), so H2 and H6a are supported. Leader support has a positive association with reappraisal and suppression and a negative association with burnout, so H3a and H7a are supported. Colleague support is positively correlated with reappraisal (β = 0.09, $p < 0.05$), so only H8a is supported. Reappraisal and suppression presented opposite effects on job burnout, so H4a and H4b are supported.

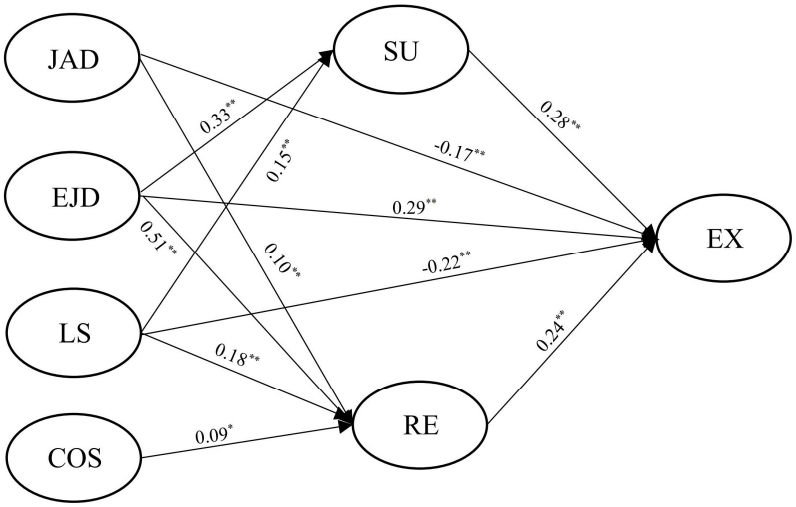

Figure 1. Relationships among job autonomy, emotional job demands, leader support, coworker support, emotion regulation, and burnout. ** $p < 0.01$, * $p < 0.05$.

4.3. Mediation Results

Mediating effects were checked on the basis of 1000 bootstrap samples, and the findings are displayed in Table 2. For the mediators, effect sizes were reported through point estimates of indirect effect. As proposed by Hayes [69], if zero is not between the upper and lower limits of the 95% confidence interval, the indirect effect is deemed to be significant. Specifically, the findings strongly suggest that reappraisal markedly mediates three things: first, the influence of job autonomy on burnout (β = −0.03; $p < 0.05$); second, the influence of leader support on burnout (β = −0.05; $p < 0.05$); and third, the influence of emotional job demands on burnout (β = −0.19; $p < 0.01$). Meanwhile, suppression simultaneously and markedly mediates the influence of emotional job demands on job burnout (β = 0.14; $p < 0.01$).

Table 2. Estimates of direct effects and indirect effects of the 95% confidence intervals.

Dependent Variable	Independent Variable	Mediation Analysis			
		Mediation Variable	Estimates (SE)	*p*	95% CI
JB	JAD	RE	−0.03 (0.01)	0.02	[−0.06, −0.01]
	EJD	SU	0.09 (0.02)	0.00	[0.08, 0.22]
	EJD	RE	−0.12 (0.03)	0.00	[−0.29, −0.10]
	LS	RE	−0.05 (0.02)	0.03	[−0.10, −0.01]

Note: JAD = job autonomy; EJD = emotional job demands; LS = leader support; COS = colleague support; SU = emotion suppression; RE = emotion reappraisal; JB = job burnout.

5. Discussion

This work adopts SDGs and the JD-R model in the higher education context, with particular attention paid to university administrative staff (UAS) and the work they perform. By investigating the job resources and job demands of this specific group, this study is designed to reveal the intricate relationships between job autonomy, emotional job demands, colleague support, job burnout, and to what extent the SDGs are achieved. Moreover, through the lens of emotion regulation, this paper examines emotion regulation as a type of personal resource. The results will be of value in improving our understanding of the work performed by university faculty staff. Before narrowing the focus to the issue of job burnout and how emotional autonomy helps to address the crisis of job burnout, we need to explain the effect of UAS job burnout on decent work conditions in higher education.

5.1. Effect of UAS Job Burnout on the Sustainable Workplace in Higher Education

The workplace atmosphere has always been found to predict the productivity of employees [70]. Dekawati [71] argued that achieving effective organizational productivity requires the implementation of ideal and supportive conditions, such as policies, procedures, fair outcomes, etc. According to SDGs 3, 4, and 8, a sustainable work environment should improve staff health and sense of well-being and create a decent workplace which can promote good-quality higher education [8]. A more sustainable workplace environment might attract more people to the profession and provide existing UAS with an incentive to stay in their jobs. However, studies show that job burnout has a negative association with a sustainable workplace atmosphere [72].

Job burnout can result in ill health. In turn, this leads to a negative outlook, cynicism, or self-doubt [19] and consequently, increasing amounts of sick leave. Unsurprisingly, these symptoms usually result in a reduction in the productivity levels of UAS. Likewise, the well-being of faculty members is a key factor in determining an organization's long-term effectiveness [73]. Many studies have shown a negative correlation between low productivity caused by job burnout and the overall health and well-being of the workforce (International Labour Organization, 2022), which contradicts SDG 3 and affects the sustainability of a sustainable workplace.

Moreover, job burnout undermines learning opportunities because a significant amount of energy is depleted handling other issues [74]. In the JD-R model, learning opportunities are classified as an essential part of job resources [9]. According to the model, these learning opportunities enable staff to cope with threatening environments and stress-laden conditions and prevent them from having to experience negative consequences [75]. Conversely, job burnout occurs when there is a lack of learning opportunities or when learning opportunities are lost as valuable resources [76]. Job burnout not only directly affects the quality of work but also seriously affects students' academic performance and social behavior [77]. These problems will directly affect the quality of the education provided. Based on this discussion, burnout affects the ability to achieve SDG 4.

The basic requirement for decent work is to obtain full-time and well-paid employment, exercise one's legal rights in the workplace, receive social security guarantees, and participate in social discussions [31]. Of course, encouraging UAS to engage in decent work is crucial for promoting overall social well-being. Toscanelli et al. [78] reported that decent work is closely associated with low levels of job burnout, and low levels of decent work will promote burnout. Therefore, in order to avoid the negative consequences of job burnout, universities must focus on decent workplace environments for UAS.

5.2. The Influences of Leader Support and Colleague Support

The study results reveal that leader support is negatively related to job burnout (H3a), while colleague support had no significant relationship with job burnout (H3b) among UAS. This finding is very different from other research studies that concerned social support as a whole, which was negatively associated with job burnout in different professional contexts [79,80]. Nonetheless, the findings suggest that leader support is better

than colleague support in reducing job burnout. The benefits of supportive leadership in reducing job burnout have been widely documented in previous research [57]. Leader support can be an essential job resource to assist UAS in dealing with high job demands and curbing the risk of burnout through reducing or buffering the overall level of stress.

However, this study also found that colleague support played a weak role in predicting UAS job burnout (H3b). This may be due to the fact that many UAS have a fixed amount or level of tasks or duties and specific responsibilities for classrooms and students which limits their opportunities to collaborate with colleagues. Additionally, UAS directly report to their leaders, who are responsible for evaluating their work, which may further diminish the importance of colleague support. Moreover, our findings indicate a positive association between colleague support and reappraisal (H8a), whereas no significant relationship was observed between colleague support and suppression (H8b). One study revealed that teachers preferred to adopt more reappraisal strategies to manage their emotions at work when they perceive their colleagues to be trustworthy, skilled, honest, and open [21]. UAS also can release and reflect on their negative emotions by sharing them with supportive colleagues or close friends, and they are more likely to interpret their work situations in a positive light, rather than suppress their negative emotions.

Furthermore, our findings established that leader support has a positive association with both suppression and reappraisal. UAS tend to employ suppression or reappraisal strategies when they perceive support from their leaders in order to maintain emotional composure and self-control. In Chinese universities, UAS are bound by management policies that increasingly prioritize output and productivity. Therefore, leaders wield significant influence over assigning tasks and evaluating the performances of UAS in administrative departments, agencies, units, etc. Consequently, leader support is more important than colleague support in terms of its relationship with the emotional well-being of UAS. Well-being is the core of SDG 3, which means that leader support contributes to achieving the SDGs by reducing UAS job burnout.

5.3. The Role of Emotional Job Demands and Job Autonomy

In line with Bakker and Demerouti's [40] conclusions, heavy job demands can cause serious health problems such as stress, energy depletion, and fatigue, while having enough job resources can be motivating and is linked to high levels of engagement, excellent performance, and better health. Our work employing the JD-R model revealed that emotional job demands and job autonomy were correlated with job burnout, strongly confirming the benefits of job resources and the detrimental role of job demands. The above results are largely in line with prior research that has employed the JD-R model in other contexts [81,82]. At the same time, it also shows that emotional job demands are opposite to SDG 3, whereas job autonomy is consistent with this goal. Job autonomy provides UAS with job security and makes it possible to realize SDG 8.

Our findings support H5b, suggesting that emotional job demands present a positive relationship with both reappraisal and suppression, while H5a was not supported. This is in contrast to most research conducted previously, which has indicated a negative association between reappraisal and emotional job demands [18]. Our findings revealed that UAS utilized both suppression and reappraisal strategies in the face of higher emotional job demands. Put differently, UAS reflected on their emotions while suppressing their true emotions to keep calm and efficiently regulate their emotions. Peng et al. [43] discovered that higher emotional demands heightened the use of coping strategies by employees, demonstrating that emotional job demands may prompt UAS to utilize suppression or reappraisal strategies. Due to the high expectations of colleagues, leaders, and the public, these reappraisal strategies are widely applied in the work carried out by UAS. Meanwhile, UAS were observed to restrain and inhibit their own emotions in order to handle the pressures of their environment.

Furthermore, our study revealed that job autonomy was positively related to reappraisal (H6a), and no remarkable association was observed between suppression and job

autonomy (H6b). This finding reveals that UAS are more likely to utilize cognitive reappraisal as a strategy to alleviate the influence of emotional needs when they have a higher degree of job autonomy. This finding concurs with prior research, meaning that teachers with high levels of job autonomy report lower levels of emotional exhaustion because they have the skills to deploy cognitive reappraisal, despite the emotional demands of their work [59]. The ability to autonomously make decisions about their tasks and how to approach them can provide teachers with a perception of empowerment and control, which can thus encourage better emotion regulation through cognitive reappraisal. These findings highlight the significance of job resources, such as job autonomy, in alleviating the negative influence of emotional demands on the emotional well-being of UAS.

5.4. The Importance of Emotion Regulation

This work explored the association between job resources and job demands on burnout simultaneously and whether or not emotion regulation functions as a personal resource. Our results reveal that reappraisal presented a negative relationship with burnout, while suppression had a positive relationship with burnout, supporting H4a and H4b, respectively. These outcomes echo the findings of prior studies, which suggested a positive relationship with reappraisal and a negative association with suppression for job burnout [54]. Individuals who use suppression tend to exhibit less optimism, lower life satisfaction, and higher levels of stress [83]. Due to the late operation of suppression in the emotional sequence, it is only poorly effective in reducing negative emotional experiences [54,83]. This is also true for UAS, since those who suppress their emotions are more likely to suffer from burnout at work.

Reappraisal is negatively correlated with job burnout since one of its major functions is to curtail the awareness of adversity at an early stage of the emotional process [54]. Qualitative research by Sutton [57] has demonstrated that teachers who manage their own emotions are more effective in their work and are better able to conform to the idealized emotional image of being a teacher. Shin et al. [84] also concluded that reappraisal was negatively correlated with burnout because reappraisal reduces the experience of disgust. Therefore, the finding is consistent with previous research. Since UAS report utilizing the reappraisal strategy more frequently, their ability to better utilize their cognitive abilities to control and reflect on their environment may contribute to buffering against the likelihood of burnout.

The present study complements this literature by incorporating personal resources into the mediating process in the JD-R model. To be specific, suppression mediated the effect of emotional job demands on burnout, whereas reappraisal notably mediated the relationships among job autonomy, emotional job demands, job burnout, and leader support. The outcomes generally agree with what prior research found involving teachers. For example, Zheng et al. and Yin et al. [85,86] discovered that emotion regulation strategies mediated the connection between teachers' well-being and emotional job demands. Our study further demonstrates that emotion regulation can function as a personal resource and serve as a mediator, and reappraisal is a critical resource that can cushion the impact of job demands on job burnout. The study is an important step toward understanding the mechanisms of UAS job burnout when effective emotion regulation strategies serve as intervention strategies.

Previous research on the JD-R model included a variety of types of personal resources, such as self-efficacy, optimism and organization-based self-esteem [9], but have neglected the ability to look after one's emotions. Reappraisal, as a personal resource, is the ability of an individual to control his or her emotions effectively and to adapt to his or her environment [9]. Reappraisal plays an important role in various professions and contexts [87,88], which is consistent with UAS-based research. Therefore, UAS who have a higher capacity for reappraisal may be better able to transform stress, gain support from leaders, and experience less job burnout. They may also be mentally healthier when compared to those who repress their true feelings. Hence, in their daily work, UAS should adjust their mindset and

reassess the situation to turn a weakness into a strength. The significance of interpersonal emotion regulation is further supported by the findings of our quantitative analysis, as prior qualitative research has revealed [89]. Overall, our study firstly underscores the importance of emotion regulation as a personal resource to alleviate job burnout and secondly suggests that job autonomy and leader support are crucial in helping UAS better control their emotions and workplace environments. These measures can lead to the SDGs being achieved in the university context.

6. Conclusions

The study utilized the job demands–resources (JD-R) model to examine the relationships between job characteristics and the burnout experienced by many UAS in higher-education institutions in China. Through this review, it is evident that job burnout among UAS warrants more attention, as the operations of universities depend heavily on UAS. Without efficient and commonsense operational systems in place, universities will not be able to provide high-quality education to students or the wider community or achieve the SDGs. Promoting the stability of teams of UAS can be addressed through interpersonal support, sufficient job autonomy, and emotional control to reduce job burnout, which can improve the well-being of UAS and promote the sustainability and economic progress of universities. In summary, it is necessary to conduct further research on the administrative personnel of universities to promote the development of these staff, who are crucial for achieving SDGs.

7. Implications for Practice

This study makes a solid contribution to the knowledge of SDGs by revealing the complex connections between job resources, job demands, burnout, and emotion regulation among UAS, generating important implications for practice. Firstly, the results emphasize the need for universities to pay more attention to job burnout and emotional well-being in UAS to achieve SDG 3, given the highly demanding and multi-task nature of university administrators' work. In order to strengthen the emotion regulation knowledge and skills of UAS, career education development should include relevant and meaningful training to provide UAS with learning opportunities, which is consistent with SDG 4. Additionally, UAS must aware of the various functions of diverse emotion regulation strategies in the context of their job burnout and working conditions.

Secondly, policymakers should consider the psychological and emotional demands of UAS as an important aspect of their well-being, which will further affect the achievement of SDG 3. Furthermore, in a leader-supported and autonomous environment, UAS are far more likely to make use of reappraisal strategies, which can greatly mitigate their sense of feeling burnt out. It is suggested that university and faculty policymakers foster supportive relationships between leaders and their lower-level colleagues and cultivate autonomous and harmonious workplace environments [90]. Facilitating collaboration among leaders and colleagues can build trust and enthusiasm among UAS. At the same time, allowing for job autonomy provides them with more control over their work, which can subsequently help generate less job burnout and greater job satisfaction. In this case, UAS will consider their job to be decent and meaningful enough to help improve the quality of education in universities to achieve SDGs 4 and 8.

8. Limitations and Directions for Future Research

There are a few limitations to be aware of in our study. First, all data were gathered via self-reporting, which may cause bias to emerge based on the employed methodology. While self-reporting is a valuable method of capturing individuals' subjective experiences, it is recommended that future research incorporate additional sources and types of data, such as observational data or reports from other stakeholders, to gain a more objective perspective on the phenomenon under study. Secondly, the cross-sectional design in this work restricted our capacity to draw causal inferences. While the hypothetical model examined in the

present study is grounded in established theories, future experimental or longitudinal designs are required to better understand the causal relationships among constructs.

Thirdly, the generalizability of the findings may be limited by the UAS sample coming from only one province in mainland China. It is important to recognize the diversity of workplaces and cultural practices, traditions, and contexts in China's many regions. With this in mind, future research may profit from a more diversified sample to truly establish the universality of the findings.

Fourthly and finally, although this study concentrated on the mediating role of emotion regulation strategies in the JD-R model, prior research indicates that personal resources can also serve as a moderator in the model. Future research may investigate the potential moderating impact of personal resources in the JD-R model and provide further insights into the complex interactions among job demands, personal resources, employee well-being, and job resources.

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References

1. United Nations. Johannesburg declaration on sustainable development. From Our Origins to the Future. In Proceedings of the Report on the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August–4 September 2002.
2. Albareda Tiana, S.; Alférez Villarreal, A. A Collaborative Programme in Sustainability and Social Responsibility. *Int. J. Sustain. High. Educ.* **2016**, *17*, 719–736. [CrossRef]
3. Boni, A.; Lopez-Fogues, A.; Walker, M. Higher Education and The Post-2015 Agenda: A Contribution from the Human Development Approach. *J. Glob. Ethics* **2016**, *12*, 17–28. [CrossRef]
4. Sonetti, G.; Sarrica, M.; Norton, L.S. Conceptualization of Sustainability among Students, Administrative and Teaching Staff of A University Community: An Exploratory Study in Italy. *J. Clean. Prod.* **2021**, *316*, 128292. [CrossRef]
5. Albareda-Tiana, S.; Vidal-Raméntol, S.; Fernández-Morilla, M. Implementing the Sustainable Development Goals at University Level. *Int. J. Sustain. High. Educ.* **2018**, *19*, 473–497. [CrossRef]
6. Dinis, A.C.; Ferraro, T.; Pais, L.; dos Santos, N.R. Decent Work and Burnout: A Profile Study with Academic Personnel. *Psychol. Rep.* **2022**, *19*, 123–147.
7. Williams, G.; Thomas, K.; Smith, A.P. Stress and Well-Being of University Staff: An Investigation Using the Demands-Resources-Individual Effects (DRIVE) Model and Well-Being Process Questionnaire (WPQ). *Psychology* **2017**, *8*, 1919–1940. [CrossRef]
8. United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*; United Nations: New York, NY, USA, 2015.
9. Bakker, A.B.; Demerouti, E. Job Demands-Resources Theory: Taking Stock and Looking Forward. *J. Occup. Health Psychol.* **2017**, *22*, 273–285. [CrossRef] [PubMed]
10. Lee, J.C.; Huang, Y.X.; Zhong, B. Friend or Foe: The Impact of Undergraduate Teaching Evaluation in China. *High. Educ. Rev.* **2012**, *44*, 5–25.
11. Liu, X.P.; Zhou, Y.Y. Research on the Impact of Job Stress on Job Satisfaction of College Teachers. *High. Educ. Explor.* **2016**, *153*, 125–129.
12. Maslach, C.; Leiter, M.P. *The Truth About Burnout: How Organizations Cause Personal Stress and What to Do about It*; Jossey-Bass: Hoboken, NJ, USA, 2008.
13. Graça, M.; Pais, L.; Mónico, L.; Santos NR Dos Ferraro, T.; Berger, R. Decent Work and Work Engagement: A Profile Study with Academic Personnel. *Appl. Res. Qual. Life* **2021**, *16*, 917–939. [CrossRef]

14. Pitman, T. Perceptions of Academics and Students as Customers: A survey of administrative staff in higher education. *J. High. Educ. Policy Manag.* **2000**, *22*, 165–175. [CrossRef]
15. Chen, H.; Liu, F.; Pang, L.; Liu, F.; Fang, T.; Wen, Y.; Chen, S.; Xie, Z.; Zhang, X.; Zhao, Y.; et al. Are You Tired of Working amid the Pandemic? The Role of Professional Identity and Job Satisfaction against Job Burnout. *Int. J. Environ. Res. Public Health* **2020**, *17*, 9188. [CrossRef]
16. Lian, L.; Guo, S.; Wang, Q.; Hu, L.; Yang, X.; Li, X. Calling, Character Strengths, Career Identity, and Job Burnout in Young Chinese University Teachers: A Chain-Mediating Model. *Child. Youth Serv. Rev.* **2021**, *120*, 105776. [CrossRef]
17. Wang, P.; Chu, P.; Wang, J.; Pan, R.; Sun, Y.; Yan, M.; Jiao, L.; Zhan, X.; Zhang, D. Association Between Job Stress and Organizational Commitment in Three Types of Chinese University Teachers: Mediating Effects of Job Burnout and Job Satisfaction. *Front. Psychol.* **2020**, *11*, 576768. [CrossRef] [PubMed]
18. Mudrak, J.; Zabrodska, K.; Kveton, P.; Jelinek, M.; Blatny, M.; Solcova, I.; Machovcova, K. Occupational Well-being Among University Faculty: A Job Demands-Resources Model. *Res. High. Educ.* **2018**, *59*, 325–348. [CrossRef]
19. Maslach, C.; Schaufeli, W.B.; Leiter, M.P. Job Burnout. *Annu. Rev. Psychol.* **2001**, *52*, 397–422. [CrossRef]
20. Xanthopoulou, D.; Bakker, A.B.; Demerouti, E.; Schaufeli, W.B. The Role of Personal Resources in the Job Demands-Resources Model. *Int. J. Stress Manag.* **2007**, *14*, 121–141. [CrossRef]
21. Yin, H.; Huang, S.; Wang, W. Work Environment Characteristics and Teacher Well-Being: The Mediation of Emotion Regulation Strategies. *Int. J. Environ. Res. Public Health* **2016**, *13*, 907. [CrossRef] [PubMed]
22. Leal Filho, W.; Shiel, C.; Paço, A.; Mifsud, M.; Ávila, L.V.; Brandli, L.L.; Molthan-Hill, P.; Pace, P.; Azeiteiro, U.M.; Vargas, V.R.; et al. Sustainable Development Goals and Sustainability Teaching at Universities: Falling Behind or Getting Ahead of the Pack? *J. Clean. Prod.* **2019**, *232*, 285–294. [CrossRef]
23. Karatzoglou, B. An In-Depth Literature Review of The Evolving Roles and Contributions of Universities to Education for Sustainable Development. *J. Clean. Prod.* **2013**, *49*, 44–53. [CrossRef]
24. Sultana, N.; Yousuf, M.I.; Din, M.N.U.; Rehman, S. The Higher the Quality of Teaching the Higher the Quality of Education. *Contemp. Issues Educ. Res.* **2009**, *2*, 59–64. [CrossRef]
25. Dicker, R.; Garcia, M.; Kelly, A.; Mulrooney, H. What Does 'Quality' in Higher Education Mean? Perceptions of Staff, Students and Employers. *Stud. High. Educ.* **2019**, *44*, 1425–1441. [CrossRef]
26. Maassen, P.; Olsen, J.P. (Eds.) *University Dynamics and European Integration*; Springer: Dordrecht, The Netherlands, 2007.
27. Baltaru, R.-D.; Soysal, Y.N. Administrators in Higher Education: Organizational Expansion in A Transforming Institution. *High. Educ.* **2018**, *76*, 213–229. [CrossRef]
28. Smerek, R.E.; Peterson, M. Examining Herzberg's Theory: Improving Job Satisfaction among Non-academic Employees at a University. *Res. High. Educ.* **2006**, *48*, 229–250. [CrossRef]
29. Fernet, C.; Austin, S.; Trépanier, S.-G.; Dussault, M. How Do Job Characteristics Contribute to Burnout? Exploring the Distinct Mediating Roles of Perceived Autonomy, Competence, and Relatedness. *Eur. J. Work. Organ. Psychol.* **2013**, *22*, 123–137. [CrossRef]
30. United Nations. *Global Sustainable Development Report*; United Nations: New York, NY, USA, 2015.
31. Nizami, N.; Prasad, N. *Decent Work*; Springer: Singapore, 2017.
32. Doucouliagos, C. Worker Participation and Productivity in Labor-Managed and Participatory Capitalist Firms: A Meta-Analysis. *ILR Rev.* **1995**, *49*, 58–77. [CrossRef]
33. Timming, A.R. Tracing the Effects of Employee Involvement and Participation on Trust in Managers: An Analysis of Covariance Structures. *Int. J. Hum. Resour. Manag.* **2012**, *23*, 3243–3257. [CrossRef]
34. Lozano, R.; Lozano, F.J.; Mulder, K.; Huisingh, D.; Waas, T. Advancing Higher Education for Sustainable Development: International Insights and Critical Reflections. *J. Clean. Prod.* **2013**, *48*, 3–9. [CrossRef]
35. Swider, B.W.; Zimmerman, R.D. Born to burnout: A Meta-Analytic Path Model of Personality, Job Burnout, and Work Outcomes. *J. Vocat. Behav.* **2010**, *76*, 487–506. [CrossRef]
36. Demerouti, E.; Bakker, A.B.; Nachreiner, F.; Schaufeli, W.B. The Job Demands-Resources Model of Burnout. *J. Appl. Psychol.* **2001**, *86*, 499–512. [CrossRef]
37. Bakker, A.B.; de Vries, J.D. Job Demands–Resources Theory and Self-regulation: New Explanations and Remedies for Job Burnout. *Anxiety Stress Coping* **2021**, *34*, 1–21. [CrossRef]
38. Bakker, A.B.; Demerouti, E.; Euwema, M.C. Job Resources Buffer the Impact of Job Demands on Burnout. *J. Occup. Health Psychol.* **2005**, *10*, 170–180. [CrossRef]
39. Brotheridge, C.M.; Grandey, A.A. Emotional Labor and Burnout: Comparing Two Perspectives of "People Work". *J. Vocat. Behav.* **2002**, *60*, 17–39. [CrossRef]
40. Bakker, A.B.; Demerouti, E. The Job Demands-Resources Model: State of the Art. *J. Manag. Psychol.* **2007**, *22*, 309–328. [CrossRef]
41. Grandey, A.A.; Melloy, R.C. The State of the Heart: Emotional Labor as Emotion Regulation Reviewed and Revised. *J. Occup. Health Psychol.* **2017**, *22*, 407–422. [CrossRef]
42. Yin, H. The Effect of Teachers' Emotional Labour on Teaching Satisfaction: Moderation of Emotional Intelligence. *Teach. Teach.* **2015**, *21*, 789–810. [CrossRef]
43. Peng, K.Z.; Wong, C.; Che, H. The Missing Link Between Emotional Demands and Exhaustion. *J. Manag. Psychol.* **2010**, *25*, 777–798. [CrossRef]

44. O'Toole, M.S.; Zachariae, R.; Mennin, D.S. Social Anxiety and Emotion Regulation Flexibility: Considering Emotion Intensity and Type as Contextual Factors. *Anxiety Stress Coping* **2017**, *30*, 716–724. [CrossRef]
45. De Spiegelaere, S.; van Gyes, G.; de Witte, H.; Niesen, W.; van Hootegem, G. On the Relation of Job Insecurity, Job Autonomy, Innovative Work Behaviour and the Mediating Effect of Work Engagement. *Creat. Innov. Manag.* **2014**, *23*, 318–330. [CrossRef]
46. Kim, H.; Stoner, M. Burnout and Turnover Intention among Social Workers: Effects of Role Stress, Job Autonomy and Social Support. *Adm. Soc. Work.* **2008**, *32*, 5–25. [CrossRef]
47. Park, R.; Searcy, D. Job Autonomy as a Predictor of Mental Well-Being: The Moderating Role of Quality-Competitive Environment. *J. Bus. Psychol.* **2012**, *27*, 305–316. [CrossRef]
48. Bakker, A.B.; Demerouti, E.; Verbeke, W. Using the Job Demands-Resources Model to Predict Burnout and Performance. *Hum. Resour. Manag.* **2004**, *43*, 83–104. [CrossRef]
49. Lim, V.K.G. Moderating Effects of Work-Based Support on the Relationship between Job Insecurity and Its Consequences. *Work. Stress* **1997**, *11*, 251–266. [CrossRef]
50. Van den Broeck, A.; Vansteenkiste, M.; De Witte, H.; Lens, W. Explaining the Relationships between Job Characteristics, Burnout, and Engagement: The Role of Basic Psychological Need Satisfaction. *Work. Stress* **2008**, *22*, 277–294. [CrossRef]
51. Fried, L. Teaching Teachers about Emotion Regulation in the Classroom. *Aust. J. Teach. Educ.* **2011**, *36*, 117–127. [CrossRef]
52. Gross, J.J. The Emerging Field of Emotion Regulation: An Integrative Review. *Rev. Gen. Psychol.* **1998**, *2*, 271–299. [CrossRef]
53. Gross, J.J. Emotion regulation: Affective, Cognitive, and Social consequences. *Psychophysiology* **2002**, *39*, 281–291. [CrossRef]
54. Gross, J.J.; John, O.P. Individual Differences in Two Emotion Regulation Processes: Implications for Affect, Relationships, and Well-Being. *J. Personal. Soc. Psychol.* **2003**, *85*, 348–362. [CrossRef]
55. Buruck, G.; Dörfel, D.; Kugler, J.; Brom, S.S. Enhancing Well-Being at Work: The Role of Emotion Regulation Skills as Personal Resources. *J. Occup. Health Psychol.* **2016**, *21*, 480–493. [CrossRef]
56. Schaufeli, W.B.; Taris, T.W. A Critical Review of the Job Demands-Resources Model: Implications for Improving Work and Health. In *Bridging Occupational, Organizational and Public Health: A Transdisciplinary Approach*; Bauer, G.F., Hämmig, O., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 43–68.
57. Sutton, R.E. Emotional Regulation Goals and Strategies of Teachers. *Soc. Psychol. Educ.* **2004**, *7*, 379–398. [CrossRef]
58. Brackett, M.A.; Palomera, R.; Mojsa-Kaja, J.; Reyes, M.R.; Salovey, P. Emotion-regulation Ability, Burnout, and Job Satisfaction among British Secondary-School Teachers. *Psychol. Sch.* **2010**, *47*, 406–417. [CrossRef]
59. Chang, M.-L.; Taxer, J. Teacher Emotion Regulation Strategies in Response to Classroom Misbehavior. *Teach. Teach.* **2021**, *27*, 353–369. [CrossRef]
60. Burić, I.; Frenzel, A.C. Teacher Emotional Labour, Instructional Strategies, and Students' Academic Engagement: A Multilevel Analysis. *Teach. Teach.* **2021**, *27*, 335–352. [CrossRef]
61. Pauw, J.; Gericke, N.; Olsson, D.; Berglund, T. The Effectiveness of Education for Sustainable Development. *Sustainability* **2015**, *7*, 15693–15717. [CrossRef]
62. Edmondson, A. Psychological Safety and Learning Behavior in Work Teams. *Adm. Sci. Q.* **1999**, *44*, 350–383. [CrossRef]
63. Hur, W.-M.; Shin, Y.; Moon, T.W. Linking Motivation, Emotional Labor, and Service Performance from a Self-Determination Perspective. *J. Serv. Res.* **2022**, *25*, 227–241. [CrossRef]
64. Grandey, A.A. Emotional Regulation in the Workplace: A New Way to Conceptualize Emotional Labor. *J. Occup. Health Psychol.* **2000**, *5*, 95–110. [CrossRef]
65. Zheng, X.; Dan, Q.; Wu, Z.; Luo, S.; Peng, X. A Job Demands–Resources Perspective on Kindergarten Principals' Occupational Well-Being: The Role of Emotion Regulation. *Int. J. Environ. Res. Public Health* **2022**, *19*, 15030. [CrossRef]
66. Maslach, C.; Jackson, S.E.; Leiter, M. *The Maslach Burnout Inventory Manual*; CPP Inc.: Mountain View, CA, USA, 1996.
67. Cheng, Y.; Luh, W.-M.; Guo, Y.-L. Reliability and Validity of the Chinese Version of the Job Content Questionnaire in Taiwanese Workers. *Int. J. Behav. Med.* **2003**, *10*, 15–30. [CrossRef]
68. Shi, D.; Lee, T.; Maydeu-Olivares, A. Understanding the Model Size Effect on SEM Fit Indices. *Educ. Psychol. Meas.* **2019**, *79*, 310–334. [CrossRef]
69. Hayes, A.F. Beyond Baron and Kenny: Statistical Mediation Analysis in the New Millennium. *Commun. Monogr.* **2009**, *76*, 408–420. [CrossRef]
70. Alwi, D.S.K.; Shaiq, D.M. Healthy Organizational Environment Enhances Employees' Productivity: An Empirical Evidence to Classical Concept. *J. Bus. Strateg.* **2019**, *13*, 49–60.
71. Dekawati, I. Improving Work Productivity Through the Improvement of Organizational Atmosphere and Culture. In Proceedings of the International Conference on Agriculture, Social Sciences, Education, Technology and Health (ICASSETH 2019), Cirebon, Indonesia, 17 October 2019.
72. Aronsson, G.; Theorell, T.; Grape, T.; Hammarström, A.; Hogstedt, C.; Marteinsdottir, I.; Skoog, I.; Träskman-Bendz, L.; Hall, C. A Systematic Review Including Meta-Analysis of Work Environment and Burnout Symptoms. *BMC Public Health* **2017**, *17*, 264. [CrossRef] [PubMed]
73. Larson, L.M.; Seipel, M.T.; Shelley, M.C.; Gahn, S.W.; Ko, S.Y.; Schenkenfelder, M.; Rover, D.T.; Schmittmann, B.; Heitmann, M.M. The Academic Environment and Faculty Well-Being: The Role of Psychological Needs. *J. Career Assess.* **2019**, *27*, 167–182. [CrossRef]

74. Bakker, A.B.; Demerouti, E.; Taris, T.W.; Schaufeli, W.B.; Schreurs, P.J.G. A Multigroup Analysis of the Job Demands-Resources Model in Four Home Care Organizations. *Int. J. Stress Manag.* **2003**, *10*, 16–38. [CrossRef]
75. Van Ruysseveldt, J.; Verboon, P.; Smulders, P. Job Resources and Emotional Exhaustion: The Mediating Role of Learning Opportunities. *Work. Stress* **2011**, *25*, 205–223. [CrossRef]
76. Lee, R.T.; Ashforth, B.E. A Meta-Analytic Examination of the Correlates of the Three Dimensions of Job Burnout. *J. Appl. Psychol.* **1996**, *81*, 123. [CrossRef]
77. Ablanedo-Rosas, J.H.; Blevins, R.C.; Gao, H.; Teng, W.-Y.; White, J. The Impact of Occupational Stress on Academic and Administrative Staff, and on Students: An Empirical Case Analysis. *J. High. Educ. Policy Manag.* **2011**, *33*, 553–564. [CrossRef]
78. Toscanelli, C.; Fedrigo, L.; Rossier, J. Promoting a Decent Work Context and Access to Sustainable Careers in the Framework of the Fourth Industrial Revolution. In *Theory, Research and Dynamics of Career Wellbeing*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 41–58.
79. Wu, F.; Ren, Z.; Wang, Q.; He, M.; Xiong, W.; Ma, G.; Fan, X.; Guo, X.; Liu, H.; Zhang, X. The Relationship between Job Stress and Job Burnout: The Mediating Effects of Perceived Social Support and Job Satisfaction. *Psychol. Health Med.* **2021**, *26*, 204–211. [CrossRef]
80. Xie, X.; Zhou, Y.; Fang, J.; Ying, G. Social Support, Mindfulness, and Job Burnout of Social Workers in China. *Front. Psychol.* **2022**, *13*, 332. [CrossRef]
81. Bakker, A.B.; Demerouti, E. Job Demands-Resources Theory. In *Wellbeing*; John Wiley & Sons, Ltd.: Hoboken, NJ, USA, 2014; pp. 1–28.
82. Schaufeli, W.B. Applying the Job Demands-Resources model. *Organ. Dyn.* **2017**, *46*, 120–132. [CrossRef]
83. St-Louis, A.C.; Rapaport, M.; Chénard Poirier, L.; Vallerand, R.J.; Dandeneau, S. On Emotion Regulation Strategies and Well-Being: The Role of Passion. *J. Happiness Stud.* **2021**, *22*, 1791–1818. [CrossRef]
84. Shin, H.; Park, Y.M.; Ying, J.Y.; Kim, B.; Noh, H.; Lee, S.M. Relationships between Coping Strategies and Burnout Symptoms: A Meta-Analytic Approach. *Prof. Psychol. Res. Pract.* **2014**, *45*, 44–56. [CrossRef]
85. Yin, H.; Huang, S.; Chen, G. The Relationships Between Teachers' Emotional Labor and Their Burnout and Satisfaction: A Meta-Analytic Review. *Educ. Res. Rev.* **2019**, *28*, 100283. [CrossRef]
86. Zheng, X.; Jiang, A.; Luo, Y. Do Servant Leadership and Emotional Labor Matter for Kindergarten Teachers' Organizational Commitment and Intention to Leave? *Early. Educ. Dev.* **2022**, 1–17. [CrossRef]
87. Wu, T.-J.; Yuan, K.-S.; Yen, D.C.; Xu, T. Building up Resources in the Relationship between Work–Family Conflict and Burnout among Firefighters: Moderators of Guanxi and Emotion regulation strategies. *Eur. J. Work Organ. Psychol.* **2019**, *28*, 430–441. [CrossRef]
88. Yin, H.; Huang, S.; Lv, L. A Multilevel Analysis of Job Characteristics, Emotion Regulation, and Teacher Well-Being: A Job Demands-Resources Model. *Front. Psychol.* **2018**, *9*, 2395. [CrossRef]
89. To, K.H.; Yin, H. Being the Weather Gauge of Mood: Demystifying the Emotion Regulation of Kindergarten Principals. *Asia-Pac. Educ. Res.* **2021**, *30*, 315–325. [CrossRef]
90. Lone, J.A.; Riege, A.H.; Bjørklund, R.; Hoff, T.; Bjørkli, C. The Relationship Between the Broader Environment and the Work System in A University Setting: A Systems Approach. *Stud. High. Educ.* **2017**, *42*, 3–22. [CrossRef]

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Sustainable Development in Higher Engineering Education: A Comparative Study between Private and Public Polytechnics

Md. Abdur Rahman Forhad [1], Gazi Mahabubul Alam [2,*], Mamunur Rashid [1], Afruza Haque [1] and Md. Sawgat Khan [1]

[1] Economic and Public Policy Research Group, Department of Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur 1707, Bangladesh; forhad@duet.ac.bd (M.A.R.F.); mrashid@duet.ac.bd (M.R.); afruza@duet.ac.bd (A.H.); sawgatkhan@duet.ac.bd (M.S.K.)

[2] Department of Foundation of Education, Faculty of Educational Studies, University Putra Malaysia, Serdang 43300, Selangor, Malaysia

* Correspondence: gazimalamb@yahoo.com

Abstract: In Bangladesh, a four-year diploma program is the highest level of technical education provided by private and public polytechnic institutions. Using representative primary data of 1372 sample sizes from Dhaka University of Engineering & Technology, Gazipur, we examined whether students graduating from private polytechnics perform worse in higher engineering education than their public school counterparts. We mainly employed a multivariate regression model and found that students from private polytechnics receive lower grades by 0.120 cumulative grade points average (CGPA) despite similar socioeconomic, academic, and demographic backgrounds. These estimated effects imply that private polytechnics fail to significantly affect sustainable engineering education. These findings suggest that policy makers increase the number of teachers and laboratory facilities for sustainable engineering education.

Keywords: private polytechnics; academic success; higher engineering education; sustainable engineering education

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1. Introduction

Due to technological progress and modernization, the demand for education for economic purposes has constantly increased for socioeconomic and national development. In addition, the global community has also highlighted the importance of increased productivity of human resources and, hence, investing in education. Furthermore, technological progress and human capital efficiency have become increasingly evident. Therefore, new skills are needed, and educational institutions usually meet this demand by providing schooling and vocational training for high-level specialists [1]. In other words, technical and vocational education and training (TVET) usually teach youths hands-on skills and job readiness to integrate into labor markets [2,3]. TVET can improve young workers' employability, productivity, and livelihoods in many developing countries. Thus, the success of a TVET institution depends on its competency in producing qualified human resources to effectively and immediately meet the operational demands in the labor market. In this study, we examined the impact of private TVET institutions, more specifically polytechnics, on further engineering education, especially in undergraduate programs. Educational attainment would be sustainable when graduates from a program succeed in subsequent academic programs or their professional careers.

In Bangladesh, the education system comprises three main streams: general, religious, and TVET. The TVET stream has four academic levels: short courses, below Secondary School Certificate (bSSC); Secondary School Certificate (SSC)-Vocational and Business Management (BM); Higher Secondary School Certificate (HSC)-Vocational; and diploma courses. Approximately 14% of students receive technical vocational education (https://

thefinancialexpress.com.bd/views/why-technical-education-is-imperative-1580483097, accessed on 20 December 2021). Ref. [4] argues that the post-secondary level for TVET in Bangladesh is diploma engineering programs. Polytechnic institutions offer diploma engineering education under the Bangladesh Technical and Education Board (BTEB). The ultimate objective is to prepare middle-level managers and technicians for specialized sectors. Students who graduate from the Secondary School Certificate (SSC) or equivalent programs can enroll in the DE program.

According to the Bangladesh Bureau of Educational Information and Statistics (BANBEIS), 250,770 students were enrolled in 2018. The total number of diploma engineering (DE) offering institutions is 439, with 223 private polytechnics. These institutions aim to produce graduates acquiring the theoretical knowledge required in the labor market. In addition, graduates are also expected to train with hands-on expertise and technologies, including interpersonal communication and learning competencies [5–8].

Although the main objective of the DE program is to produce a mid-level technical supervisory workforce, some of these graduates want to pursue their higher studies in a Bachelor of Engineering (BSc Engineering) program. Students from general backgrounds can also pursue higher engineering programs as in other countries. Recently, Ref. [9] argued that students from lower socioeconomic backgrounds are more likely to receive lower grades in higher engineering education. They also show that the previous institutional environment or category would play an essential role in shaping graduates' professional careers.

In Bangladesh, polytechnic graduates pursue higher engineering education at the Dhaka University of Engineering and Technology (DUET), Gazipur. As these technically-proficient DE graduates are academically competent, they are highly likely to succeed in their higher education. Moreover, as engineering education is theoretical and laboratory-oriented, polytechnic institutions must offer such facilities to their graduates. Refs. [10,11] argue that a well-connected organizational structure with required equipment is essential in innovating and achieving an institution's ultimate goal. However, some argue that most private polytechnics in Bangladesh do not have sufficient logistics to produce graduates demanded in the job market. Therefore, focusing on the academic institution, we examined whether students graduating from private polytechnics are making significant progress in further engineering education.

Engineers have played a significant role in shaping economic development, and their importance is consistently increasing at national and international levels [12]. When universities produce graduates with innovative skills, they will succeed in professional careers and create innovative technologies to meet upcoming challenges [13]. Therefore, many countries take initiatives to improve the standard of their technical education. For example, to reform academic curricula, the Singapore University of Technology and Design (SUTD) signed an academic collaboration with the Massachusetts Institute of Technology (MIT), one of the world's leading engineering universities. In Bangladesh, Dhaka University of Engineering and Technology (DUET) is one of the largest universities that mainly offers engineering education at a higher level only for diploma graduates. As DE graduates already have a four-year engineering education, they are likely to perform better in their subsequent academic programs. Therefore, measuring their performance is essential to ensure quality education.

Ref. [14] shows that DE graduates have limited opportunities for higher engineering education in the public education systems. For example, only one public institution offers a BSc education, while the other four engineering universities provide the same programs for general students. In addition, most science and technology universities offer BSc Engineering programs for general students. Furthermore, other public universities, such as Dhaka and Rajshahi University, offer engineering programs, and DE graduates do not even qualify for admission. On the other hand, DUET only offers further engineering academic programs, regardless of private or public polytechnic type. Ref. [15] shows that students in private universities have a higher level of perception, knowledge, attitudes, and practices

toward sustainability than their public school counterparts. Other studies, such as [16], show that private university students emphasize reputation values, selectivity, personal interaction, facilities, and cost. In contrast, public university students valued programs, athletics, reputation, cost, housing, and location. More recently, educators emphasized creating a scientific environment to adapt to corporate responsibility in higher education. Furthermore, students in private institutions are more engaged with learning legal, ethical, and philanthropic practices than their public school counterparts [17].

In this study, we examine how DE graduates from private polytechnics perform in higher engineering education compared to their public school counterparts. The findings suggest that students from private polytechnics receive lower grades in the higher engineering program than their public school counterparts. The results also reveal that private polytechnics have insufficient quality teachers. In addition, most polytechnic students, teachers, and other stakeholders urge the recruitment of more quality teachers. Quality polytechnic education would offer sustainable technical and vocational education, ultimately leading to sustainable engineering practices. Therefore, this study significantly contributes to identifying the problems in private polytechnics and then providing possible solutions. Furthermore, as educational institutions are the most prominent stakeholders in training individuals on technological development, this study will offer policy recommendations for promoting productivity, innovation, and economic activities.

Following the United Nations as a follow-up action plan of the millennium development goals (MDGs) 2015, Bangladesh also wants to achieve the sustainable development goals (SDGs) by 2030. TVET and skills development have become prime policy priorities for many governments to address youth unemployment, required for the advancement of globalization and new technologies. Our findings offer a comprehensive scenario of the existing polytechnics and potential avenues to provide quality technical education for building skilled human resources, and therefore, to achieve the sustainable development goals.

The study is organized as follows. Section 2 describes the research statement and a brief description of the technical education in Bangladesh. Section 3 describes the data collection process with a detailed sampling strategy and provides the empirical model to examine the effect of private polytechnics on higher engineering education performance. Section 4 reports and discusses the findings. Section 5 concludes, and finally, Section 6 discusses the potential limitations of the study.

2. Background

2.1. Research Statement

As education and socioeconomic backgrounds supplement each other [18], their relationship is reciprocally symbolic. For example, education increases individuals' incomes, which usually improves their social and economic conditions. Education is considered the most crucial component of economic and social development [19]. A well-informed education system resolves the discriminatory scenario raised from an ongoing practice privileged by socioeconomic backgrounds [9]. Education has three main provisions, primary, secondary, and higher education, which are globally recognized, and their roles in shaping the world are identified and demarcated. After completing secondary education, many individuals enroll in a higher education program. In the United Kingdom (U.K.), higher education institutions used to be divided into two categories, universities and polytechnics [20]. These institutes primarily aim to produce skilled human capital in the labor market [21,22]. The education system in most former British colonial states mostly follows the U.K. system [23,24].

Ref. [25] argues that the university's primary purpose is to produce *elite leaders* to run a country, while polytechnics concentrate on training *specific skilled-based* professionals, such as engineers and doctors. Leaders created by universities usually belong to a socioeconomically privileged background [26]. On the other hand, individuals with middle and lower socioeconomic backgrounds are often neglected by their university counterparts. Within the British colonial settings, leaders produced in the university system mainly ruled

polytechnic institutions and their graduates' professional careers. Studies have found that a smaller proportion of polytechnic graduates went to conventional universities. For example, compared with the traditional system, a negligible amount of polytechnic graduates went to university for further education in the U.K. At the same time, some countries under former British colonial rule did not allow their polytechnic graduates to enroll in conventional universities [26].

In the late 1990s, the U.K. system transformed its polytechnics into universities. Many former British colonies established specialized engineering universities to access polytechnic graduates. However, these polytechnic graduates cannot enroll in conventional or elite universities by legislation. In contrast, they provide access to a socially privileged group, and not individuals from lower socioeconomic backgrounds [9]. This practice indicates that the higher education model for polytechnic graduates in these British colonial regions does not entirely follow the British system.

The beginning of engineering education has a historical base in Bangladesh. During the British colonial period, the Ahsanullah School of Engineering (ASE) was the foremost institute established in the Bengal region for engineer-related job training. This ASE institute was later converted into a polytechnic institution [27]. After the British colonial period, the ASE was transformed into an engineering university and renamed the East Pakistan University of Engineering and Technology (EPUET). After its independence in 1971, it was further renamed Bangladesh University of Engineering and Technology (BUET). After its transformation into a university, its rules and regulations were entirely changed. One of the changes was that polytechnic graduates are not now eligible for higher education at BUET. BUET and its affiliated or similar institutions, such as the Bangladesh Institute of Technology (BIT), now allow only higher secondary graduates from the science cluster [27]. The BITs started to become engineering universities in 1999 following an ordinance. Five engineering universities offer engineering degree programs leading to Bachelor's, Master's, and Ph.D. qualifications. However, only higher secondary graduates can apply for four-year Bachelor's programs in these universities [27]. On the other hand, graduates from polytechnic institutions, sometimes called diploma engineers, cannot qualify for admission to Bachelor's programs in these elite universities.

These diploma graduates can enroll only in BIT, Dhaka, for further education. In 2003, BIT, Dhaka, was transformed into a university and later renamed the Dhaka University of Engineering and Technology (DUET). Other BITs are also renamed as Chittagong University of Engineering and Technology (CUET), Khulna University of Engineering and Technology (KUET), and Rajshahi University of Engineering and Technology (RUET). Like other engineering universities, DUET offers degree programs leading to Bachelor's, Master's, and Ph.D. qualifications. The difference is that only diploma engineers are allowed to apply to DUET. Graduate engineers from DUET already completed a four-year engineering degree in polytechnics, indicating that eight years are needed to become a Bachelor of Engineering graduate. In contrast, graduates from other engineering universities, such as BUET and CUET, spend only four years completing the same engineering programs.

Studies such as [28–31] consistently show the relationship between socioeconomic status and educational achievements. Refs. [32,33] argue that students from lower-income families are more likely to face academic challenges. Although it is not unanimously clear, many studies explain such effects ranging from the inequitable distribution of resources and opportunities to variations in the family's day-to-day interactions [34,35]. Ref. [36] argues that schools with higher average socioeconomic status tend to receive a higher average score than their whole intake. In other words, a group of high-SES students in a school usually offer an environment associated with even better attainment than an individual student's SES alone. For example, parental educational status and family income are positively correlated with better academic expectations for their children [37–41]. Ref. [36] also argues that the opposite is true for students with lower socioeconomic status. Therefore, when students with lower socioeconomic status are grouped in a school, their lower educational attainment could be exacerbated. For example, Refs. [38,39] argue that lower-SES parents

usually have fewer expectations than their high-SES counterparts and are less likely to invest in their child's learning.

Most previous studies compare students with higher SES with lower SES assuming similar academic credentials. Recently, [9] examined the effect of SES in higher engineering education. As a prior engineering program likely offers an absolute advantage to undergraduate students, they are more likely to overcome the effects of SES in their subsequent program in the same disciplines. Despite a more comprehensive education in similar academic programs and socioeconomic backgrounds, few studies argue that private or public technical institutions remain critical in academic and professional engineering education achievements. In this study, we examine the impact of private polytechnics on furthering higher engineering education.

2.2. Technical Education and Economic Development

While the university usually produces systematic scientific knowledge, vocational education training offers hands-on training with expertise for a specific occupation [42]. Therefore, the success of a university depends on its contributions to the respective scientific discipline, while the success of vocational education is concerned with the ability of students to accomplish useful work. In addition, socioeconomic and political components could also affect the development of the university and vocational education establishment process [43,44]. Therefore, beyond compulsory education, many educational institutions, including elite higher education, polytechnics, and different levels of vocational institutions, simultaneously work to train doctors, teachers, and lawyers in countries around the globe. For example, Germany and the United Kingdom operate capitalist economies but have different approaches to higher education and TVET [45]. Higher education in Germany is more vocationally oriented than the U.K., with specific skills tied closely to a particular occupation. In contrast, in the U.K., higher education is generally not concentrated on specific occupational fields since it is considered reasonable for individuals to invest in developing general and transferable skills. However, they have a wide range of highly specialized, short-term programs offering vocational qualifications.

Despite the different vocational programs in many countries, they always significantly contribute to national development. This is because these institutions highly concentrate on knowledge creation, basic societal problem identification, and efficient solutions. Moreover, in the fourth industrial era, engineering education institutions in developed countries revised their academic curricula to meet the upcoming challenges and ensure the desired economic growth [46].

2.3. Sustainable Development Goal 4: A New Outlook to TVET

TVET and skills development have become a prime policy priorities for governments to address youth unemployment, skills mismatch, skilled migration, and new skill requirements for globalization and new technologies. Therefore, the national TVET reform initiative has received global recognition for skills development and lifelong learning. Moreover, following the Sustainable Development Goals (SDGs), TVET and lifelong learning have been given the highest priority in global educational development agendas, serving to improve their current status to international standards https://unesdoc.unesco.org/ark:/48223/pf0000246300, accessed on 18 December 2021. More specifically, SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for everyone.

The United Nations, through SDG 4.4, aims to significantly increase the number of youth and adults with relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship. In addition, the objective is to ensure equitable access to quality TVET programs with increased and diversified learning opportunities. Similarly, beyond work-specific skills, the UN emphasizes developing high-level cognitive and non-cognitive skills, such as problem-solving, critical thinking, creativity, teamwork, communication skills, and conflict resolution, to use across various occupational fields.

Although it is recognized that effective TVET policies strengthen long-term and inclusive economic growth [47], this system remains underdeveloped and poorly managed in many countries [47,48].

2.4. Technical Education in Bangladesh

Technical education has contributed to human resource development since the 1870s. During the British colonial period, the School of Engineering was first established in 1874 as the center for technical education in Assam and undivided Bengal (This School of Engineering is currently operating as the Bangladesh University of Engineering and Technology (BUET)). Later, one private and 21 public technical institutions offered technical education during the British colonial period. After the partition of this subcontinent, according to the Council of Technical Education report in Pakistan in February 1949, two polytechnic institutes were established in Karachi and Dhaka. Then, using financial assistance from the Ford Foundation of America, East Pakistan Polytechnic Institute was established, which is currently named Dhaka Polytechnic Institute.

Figure 1 shows the technical educational structure. Students can enroll in vocational programs at the secondary level after completing the eighth grade. These programs are the SSC and Dakhil vocational. After completing these 10th grade-equivalent programs, they can enroll in higher secondary or diploma programs. These diploma programs mainly offer education in engineering and technology. However, after completing a four-year engineering program, graduates can be admitted to only one government-operated engineering university, Dhaka University of Engineering and Technology (DUET), Gazipur. This university was established exclusively for diploma graduates. Therefore, higher secondary graduates are not allowed to apply for DUET admission. Similarly, diploma students cannot earn admission to other publicly financed engineering universities. However, diploma graduates can pursue engineering programs at private universities.

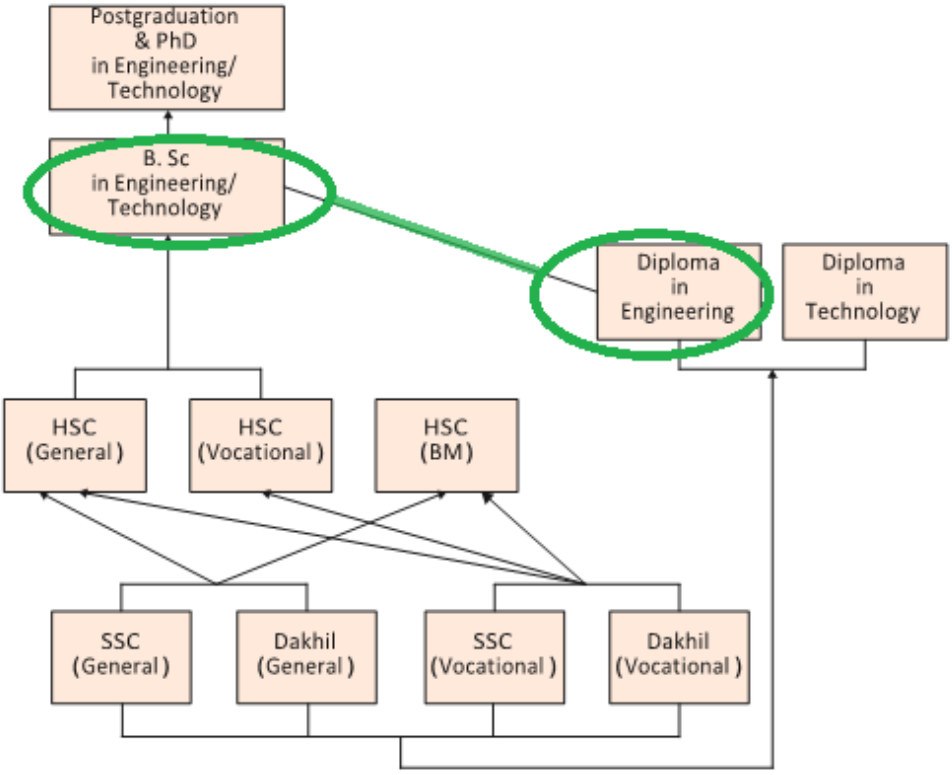

Figure 1. Technical education structure in Bangladesh. BM = business management, B. Sci. = Bachelor of Science, HSC = higher secondary certificate, SSC = secondary school certificate. *Dakhil* General and *Dakhil* Vocational are equivalent to SSC General/Voc in *madrasah*. *Madrasah* refers to religious schools for the study of the Islamic religion. Source: BTEB.

After the independence in 1971, 33 public and 20 private technical institutions were established until 1990. However, the number of technical and vocational institutions was not significantly increased compared to the previous 24 years' regime under the Pakistan period. Some pointed out the political instability during this period. However, between 1991 and 1999, the number of institutions rose remarkably. About 17 public and 248 private technical institutes were established during that period.

In the 2000s, the government realized that students graduating from different academic programs do not obtain their desired employment opportunities and paid more attention to promoting vocational and technical education. Therefore, the government began to widen the specialized educational institutions throughout the country. As a result, 126 public technical institutions were established, and 746 private technical institutions were approved around the country. From 2001 to 2005, 37 public technical institutions were founded, and 1554 private technical institutions were permitted. However, the ratio of students and teachers in both sectors was not increased proportionally due to the negative conceptions of technological education sectors.

Since establishing the BTEB in 1969, it has helped meet the increased demand for technically skilled workers. In addition, TVET has experienced growth and diversification. For example, several government ministries have become involved, private organizations have created internship training opportunities, and NGOs have provided training. Furthermore, in 2004, polytechnic institutes raised the duration of the Diploma in Engineering program from a three-year program to a four-year program. However, students showed little interest in studying at the polytechnic institutes. For example, an estimated 135,000 seats remain empty across the country. Approximately 127,976 of the 185,055 seats at the 511 private polytechnic institutes were vacant in 2019–2020. At the 49 government institutes and 64 technical schools and colleges, 7127 of 56,170 seats were vacant. To overcome this situation, BTEB admits SSC graduates with 2.50 CGPAs as the minimum qualification. To implement Vision 2041, the government aims to promote youth's skilled human resources in the technological and industrial era. Therefore, the government plans to establish 576 public technical institutions, approve 390 private technical institutions, and recruit more teachers. However, not all schools will offer Diploma in Engineering programs.

3. Research Design

3.1. Data and Sampling Framework

We collected primary data from Dhaka University of Engineering and Technology (DUET), the only public university that offers higher engineering education for DE graduates. In addition, we collected data from students of all departments: Civil Engineering (CE), Computer Science and Engineering (CSE), Electrical and Electronics Engineering (EEE), Mechanical Engineering (ME), Textile Engineering, Architecture, Industrial and Production Engineering, Materials and Metallurgical Engineering (MME), and Chemical and Food Engineering (CFE). The survey duration for the study was November 2021 to February 2022. As this study focuses on academic success, we considered students who completed at least one semester. The main reason for considering students who completed one semester is that the subsequent institution evaluates the student's academic success. Furthermore, we assumed the CGPA to measure academic success. To determine the representative sample size, we mainly employed the [49] formula:

$$n = \frac{N}{1 + N(e)^2}, \tag{1}$$

where n is the sample size, N is the total number of graduates, and e is the significance level or the level of precision. Table 1 shows the department-wise sample distribution. The four largest departments have 120 students in each session, while TE has 60, and other departments have 30 students. As the MME program started in the 2020–2021 academic session, it has only two batches with 60 students.

Table 1. Sample distribution among departments in DUET.

Department	Population Size	Sample Size
Civil Engineering (CE)	480	218
Computer Science and Engineering (CSE)	480	218
Electrical and Electronics Engineering (EEE)	480	218
Mechanical Engineering (ME)	480	218
Textile Engineering (TE)	240	150
Industrial and Production Engineering (IPE)	120	92
Architecture (Arch)	150	109
Materials and Metallurgical Engineering (MME)	60	52
Chemical and Food Engineering (CFE)	120	92
Total	2610	1369

We also used qualitative data to validate the results from the quantitative data. Given the nature of the research questions, we collected data from the professors at DUET, instructors at polytechnics, administrators, and BTEB officials. We mainly used semi-structured interviews. Some questions were also open-ended. To maintain confidentiality, we coded each of the respondents. Following the department abbreviation, we use codes for each respondent. For example, for the first respondent of the ME department, we use the code ME01. This coding was made in the interest of respondents' anonymity and to meet the ethical and confidentiality requirements in research. We also reviewed government documents, newspapers, and other published reports to validate quantitative and qualitative data results.

3.2. Methodology

We mainly employed the following multivariate regression model:

$$y_i = \alpha_0 + \alpha_1 \, x_i + \alpha_2 \, z_i + e_i, \tag{2}$$

where y_i is the GPA of student i in a BSc program; x_i is a binary indicator for private polytechnics; z_i represents the other factors, including sibling or parental education income, hours of study, and urban areas; and e_i is the error term. The leading coefficient of interest, α_1 is expected to be positive and statistically significant, indicating that private polytechnics positively impact academic achievements at higher levels. Depending on other influencing factors, the sign for the α_2 would be different. This study considers DE GPA, study hours, peer effects, and socioeconomic backgrounds as control variables. Socioeconomic background might have an impact on students' academic attainment. This study considers family income and urban status as socioeconomic backgrounds. Family monthly income is measured in Bangladeshi Taka. We use a binary indicator of whether students come from urban areas for urban status. The study duration is measured in total weekly hours spent on learning, except the class hours in DUET. We use females as a binary indicator for female students for demographic status. The peer effects are measured in academic attainment in the same class.

For the qualitative study, we interviewed respective departmental chairs in DUET and DEs. For each respondent, we use an anonymous code following their department abbreviation. For example, we use EEE01 to refer to the first respondent from the EEE department. We briefed them on the research purpose, focus, and confidentiality before the interviews. Each interview lasted 45–60 min. We also allowed each interviewee to share their experiences or observations openly, revealing additional useful information. The sequence of the interview questions was altered ad hoc to maintain a friendly discussion.

4. Results Analysis

4.1. Descriptive Statistics

Figure 2 shows the percentage distribution of surveyed students with their government and private polytechnic institutions. Only 5.78% of the total students came from private institutions pursuing higher engineering education in higher engineering programs. Approximately 98% of them said that the main reason for the lower enrollment is lower motivation to pursue higher engineering education. Their ultimate goal is to enter the job market after graduating from the diploma programs.

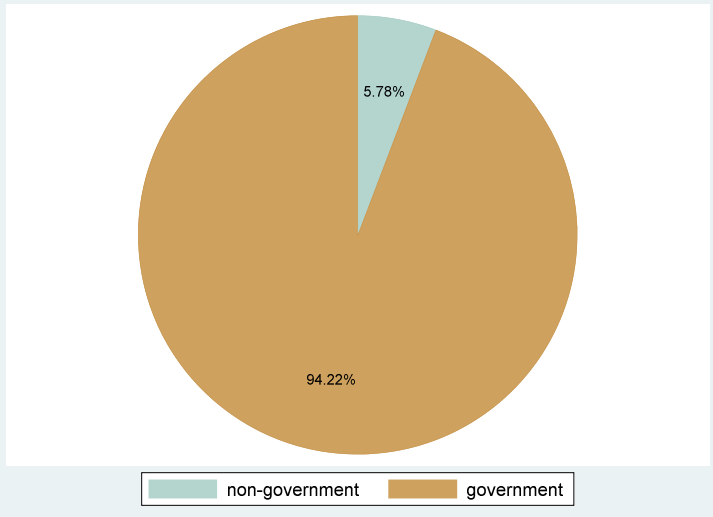

Figure 2. Percentage distribution of students with polytechnic backgrounds.

We also examined the percentage distribution of students with their demographic location. Following the urbanization scale, this study mainly considers location under five categories: capital, city corporation, districts, sub-districts or Upazila, and villages or unions. Approximately 80% of the total students came from a village or union. About 3.17% of the students came from government institutes, while 4.17% were from private technical institutions.

Table 2 summarizes the statistics of the surveyed students. The mean cumulative grade point average (CGPA) in DUET for students from public institutions is 3.23 on a scale of 4.00, and 3.22 for students from private polytechnics. The CGPAs of former public and private students in the DE programs are 3.63 and 3.71, respectively. Additionally, the standard deviation for both averages of CGPAs is almost similar, indicating that students from both institutions are likely to be identical in their overall academic backgrounds. Table 2 also shows that their average daily study time is almost 6 h. The average family income for the government polytechnic students is 18,206 Bangladeshi Taka (BDT) and 19,478.99 for the students from private institutions. Although students of private institutions came from relatively economically stable families, they are still below the nationally represented family income.

These statistics indicate that most students who attended diploma programs are mainly from lower socioeconomic backgrounds.

Most students received private tutoring to gain admission to DUET. Table 2 shows the average number months of tutoring for private and public students, approximately 18 months and 16 months, respectively. They usually attend private tutoring centers after completing their seventh semester of the DE programs. Most of them completed their industrial attachment by staying near DUET. They also argue that the educational system in the DE programs is not the same as that required for a successful DUET admission. This indicates that the programs are not synchronized in academic curricula and practices. Table 2 also shows a higher percentage of female students from government institutions enrolled in higher education programs.

Table 2. Summary of statistics.

	(1)	(2)	(3)
Variable	**Number of Observations**	**Mean**	**Standard Deviation**
	Panel A: Government Polytechnic Institutions		
DUET GPA	1543	3.23	0.40
DE GPA	1764	3.63	0.29
Study hours	1769	5.59	2.77
Family income	1718	18,206.34	17,823.10
Urban	17	0.56	0.67
Number of industrial tours	1752	2.49	1.69
Months of private tutoring received for DUET admission	1785	17.51	7.53
Female	1794	0.10	0.29
	Panel B: Non-Government Polytechnic Institutions		
DUET GPA	103	3.22	0.42
DE GPA	120	3.71	0.19
Study hours	118	5.62	2.76
Family income	119	19,478.99	13,560.82
Number of industrial tours	120	2.98	1.70
Months of private tutoring received for DUET admission	121	16.38	7.35
Female	121	0.03	0.18

4.2. Empirical Estimation Results

Using the regression model in Equation (2), Table 3 shows the impact of private polytechnics on academic achievement in higher education programs. Column 1 shows the average difference in DUET CGPAs between private and public students. Similarly, Column 2 shows the same effect of the private polytechnics on DUET CGPAs, incorporating family income as a control variable. However, the estimates of the non-government polytechnics are not statistically significant at 10%. These findings make sense, as only the institutional backgrounds do not significantly affect academic attainments. In Column 2, the family income estimates are insignificant. This implies that the types of polytechnics do not have impacts when no control or income is considered as a control variable. However, academic CGPAs do not only depend on parental income. Many other socioeconomic and individual characteristics could have an impact on educational attainment. Columns 3 and onwards of Table 3 show the estimated effects considering more control variables. Individual ability could impact students' CGPAs. Column 3 incorporates students' ability to use their previous academic attainment as a representative proxy. In such a case, private polytechnics' estimated effect is -0.111, and it is significant at 1%. The impact of ability is also significant. These results imply that students from private polytechnics could receive lower grades than their government institution counterparts.

Column 4 shows the estimated effects considering the study hours in the model. This study assumes the study hours per day. The estimated coefficient of study hours is also positive and significant at 1%. The findings imply that students spending more time on their studies receive higher academic attainment. The estimated effect of private polytechnics is also negative and statistically significant. Demographic characteristics, such as gender and location, could also impact educational attainment. Columns 6 and 7 in Table 3 show a negative effect of gender, female, on academic achievement. These findings imply that female students receive lower grades than male students. In each case, the estimated impacts of private polytechnic experience are statistically significant.

Table 3. Impact of attending private polytechnics on academic achievement in higher education programs.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Non-government	−0.019	−0.035	−0.108 ***	−0.111 ***	−0.112 ***	−0.122 ***	−0.120 ***
	(0.040)	(0.041)	(0.037)	(0.037)	(0.037)	(0.037)	(0.036)
Family income		−0.011	0.008	0.010	0.008	0.011	0.016
		(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)
DE GPA			0.642 ***	0.640 ***	0.640 ***	0.639 ***	0.509 ***
			(0.030)	(0.030)	(0.030)	(0.030)	(0.034)
Study hours				0.010 ***	0.010 ***	0.010 ***	0.009 ***
				(0.003)	(0.003)	(0.003)	(0.003)
Urban					0.070	0.080 *	0.091 **
					(0.044)	(0.044)	(0.043)
Female						−0.097 ***	−0.102 ***
						(0.033)	(0.032)
Peer effect							0.378 ***
							(0.029)
Constant	3.234 ***	3.336 ***	0.839 ***	0.774 ***	0.783 ***	0.765 ***	0.064
	(0.010)	(0.128)	(0.163)	(0.165)	(0.165)	(0.165)	(0.170)
Observations	1646	1572	1541	1518	1518	1513	1372
R-squared	0.000	0.001	0.231	0.237	0.238	0.241	0.336

The dependent variable in all columns is the CGPA in DUET. Standard errors are in parentheses. ***, **, and * represent significance levels at 1%, 5%, and 10%, respectively.

Academic institutional quality sometimes seems to be judged on students' excellence rather than on the quality of teaching or other educational logistics. Therefore, many argue that the background and abilities of students must influence their achievements at school. Academic literature measures the consequences of social interactions between pupils, termed peer group effects. Students meet new and unfamiliar peers when they go to school. Column 7 in Table 3 incorporates the peer effects into the model. The estimated impact of peer effects is positive and statistically significant, indicating that students with higher-ability peers have higher attainment. The estimated impact of private polytechnic attendance is −0.120 and is statistically significant. These imply that students from private polytechnics receive lower grades than their public school counterparts. Considering socioeconomic, academic, and demographic backgrounds, Table 3 shows that government polytechnic students perform better, although they have similar educational qualifications.

4.3. Discussion

The relationship between socioeconomic factors and academic attainment is one of the critical issues in the literature. For example, according to the Colman Report, schools usually have a limited effect on students' academic outcomes compared to students' abilities embodied before coming to school. Furthermore, disparities inherited from the home, neighborhood, and peer groups create inequalities in students' post-school professional career. Table 2 shows that the average income of private students' families is higher than their public school counterparts. However, in Table 3, family income does not significantly impact academic attainment. Students' location backgrounds are also similar. Regardless of the originating location, most students came from rural areas.

Besides theoretical knowledge, engineering students should have technical laboratories and have experimental opportunities or hands-on training on the different technologies. Moreover, they should have practical experience on all the topics covered in their syllabi and needed in the labor market. Figure 3 shows the percentage distribution of the experimental equipment. Almost 60% of the surveyed private students complain that they only have 0–10% of the total required laboratory equipment.

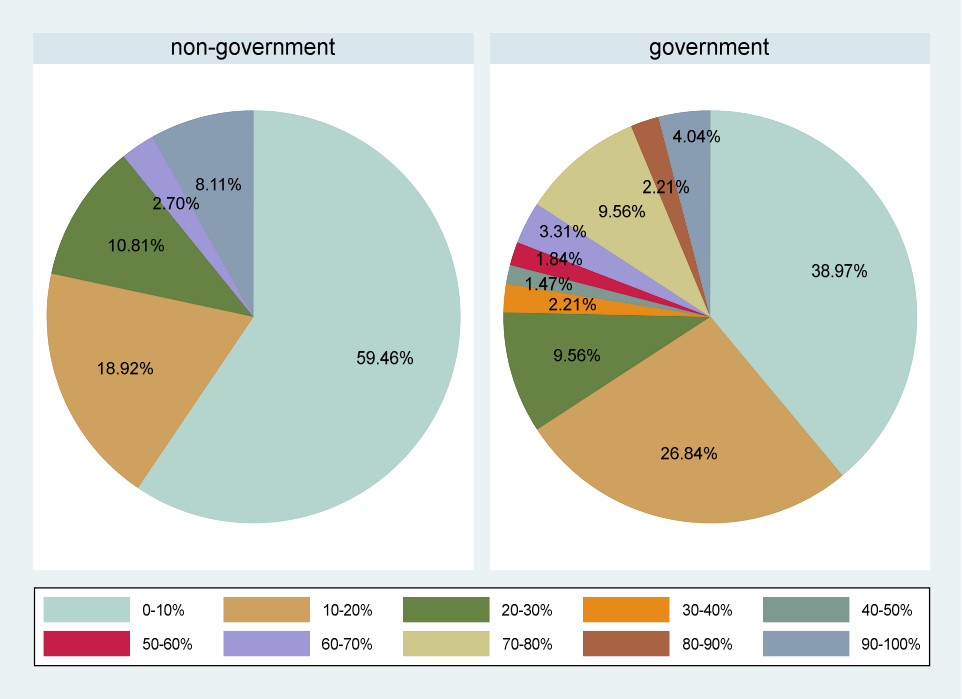

Figure 3. Percentage distribution of the practical equipment in 2021.

Students surveyed in this study argue that most private polytechnic students are not admitted to DUET for higher education programs. Instead, they come from the same institutions every year, such as Mirpur Polytechnic Institute, Shyamoli Ideal Polytechnic Institute, and National Polytechnic Institutes. Although there are more than 380 private polytechnics across the country, most DUET students have mainly come from particular private institutions. The findings suggest that approximately 98% of the total DUET students graduated from only 10% of the country's total polytechnic institutions. These statistics indicate that the remaining 90% of private institutions are presented in the empirical analysis.

We conducted a qualitative survey at some of these institutions to complement this result. Most of these institutions do not even have teachers for each subject, regardless of permanence. For example, a teacher of a private polytechnic, PTE11, reported to the Business Standard that they have 210 students per teacher for a total of 2100 students (https://www.tbsnews.net/bangladesh/education/polytechnic-institutes-are-shambles, accessed on 2 February 2022). He further noted that:

> *"We are trying to provide a world-class education for our students. But we sometimes fail because we have an inadequate number of teachers."*

Moreover, there is no minimum state or BTEB requirement for the number of teachers for each subject, premises, and other academic logistics. For example, teachers must also carry out clerical work.

One of the professors at DUET, ME01, who used to work as an instructor in polytechnic institutions, said that he had to teach more than 58 h of classes weekly. In addition, the teacher earlier interviewed in the Business Standard further asked a question:

> *"How can we teach such a large number of students when there are so few teachers?"*

We also used government, non-government, and other newspaper documents to validate the qualitative findings. Figure 4 shows the summary of technical education in Bangladesh. More than 220 out of 387 private institutions do not have a permanent building to conduct their classes. For example, the Bangladesh Institute of Technology has six teachers and over 500 students in a survey reported in the Business Standard. Furthermore, they have only one teacher with a permanent position. On the other hand,

the average student–teacher ratio is 120:1 for public polytechnics. This information is also validated by students surveyed in each department.

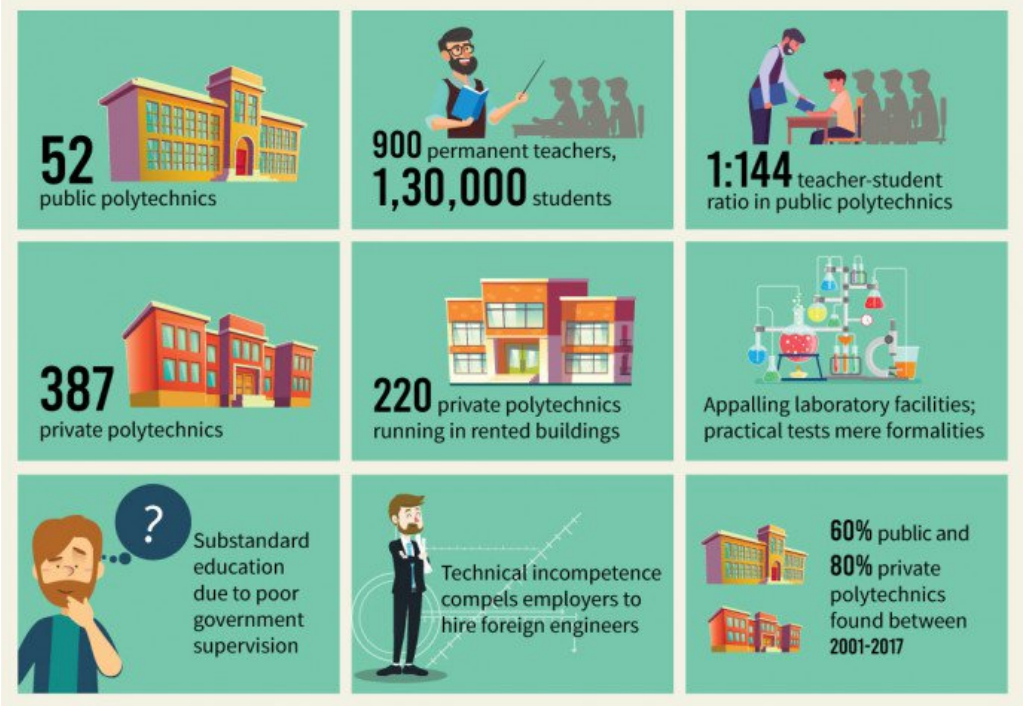

Figure 4. A summary of polytechnic institutions in 2018. Source: The Business Standard.

To complete the diploma program, a student must complete eight semesters. According to the rule, the respective institutes control the first three semesters. The Bangladesh Technical Education Board conducts examinations for the subsequent four semesters, and the remaining semester is the industrial attachment. In addition, practical examinations are a mere formality in most institutions, where students only need to be present at the exam centers. One of the principals of a private polytechnic, PTE021, told the Business Standard that his institution has good connections with officials of the technical board. Hence, the principal argued:

> *"This makes everything easy for us. We can even manipulate the practical test scores of the students. We control everything as I was the Chemical and Food Department chief at a Public Polytechnic Institute. A student can get a certificate if they attend some lectures and follows our guidance."*

A former Dean of the Faculty of Mechanical Engineering at DUET (ME19) advised to appoint an assessor of the polytechnic exam instead of the current system. He has considerable experience with technical education both in DUET and DE. He pointed out that the existing evaluation does not motivate students to learn and build themselves human resources, regardless of pursuing further education or going to the job market.

More than 80% of private institutions and 60% of public institutions were founded between 2001 and 2017. However, only a few have classrooms and other laboratory facilities. In a conversation with the Business Standard, one of the Bangladesh Private Polytechnic Owners Association secretaries said that the lack of strong supervision from the government is the main reason for poor quality education in many private polytechnic institutes (https://www.tbsnews.net/bangladesh/education/polytechnic-institutes-are-shambles, accessed on 2 February 2022). He noted that

> *"Some private institutes are doing better than the government ones. However, a good number of private institutes only have signboards. They get the attention of potential students by advertising the technical board's approval."*

He further added:

"However, after admission, the students have to do nothing. Only a strong monitoring system from the government can help improve the quality of education in these institutes."

We also validated the above findings with other faculty members in DUET. We also interviewed faculty from other institutions such as BUET and CUET to validate the results. Some of them argue that academic collaboration between DUET and polytechnics is essential. As DUET is the only public university to offer higher engineering education for DE graduates, they are familiar with the strengths and weaknesses of the polytechnics. Studies such as [50–52] emphasize academic collaboration to design technology support for knowledge creation to face the contemporary challenges in academia and industries. The collaborative activities would allow diploma institutions to become familiar with cutting-edge engineering education and produce technically skilled human resources required for the job market.

5. Conclusions

Technical and vocational education prepares human resources to promote economic development, explain employment and production opportunities, and improve employment quality. In Bangladesh, two types of polytechnic institutions offer technical and vocational education. In this study, we examined how private institutions perform compared to their public school counterparts. Examining academic attainment in higher engineering program, we found that students graduating from private polytechnics perform worse than their public school counterparts. This study also finds that private polytechnics have a lower number of teachers and laboratory facilities.

While most previous studies argue about students' perceptions, the findings of this study comprehensively incorporate both perspectives. For example, using students' perception in a five-point Likert scale questionnaire, Ref. [15] argues that private universities in China have a better reputation than their public school counterparts. In contrast, using a more rigorous multivariate regression method, this results of this study indicate that private polytechnic students do not perform as well as their public school counterparts. In addition, we used CGPA as a measure of academic achievement, a widely accepted standard for educational attainment. The study findings also emphasize that private polytechnics have limited academic logistic support. As the results are validated by the demand and supply perspective of the polytechnic graduates, they are more comprehensive. Ref. [53] identified similar challenges in New Zealand, including constraints for academic staff, lack of time, high workloads, insufficient support, and inadequate resources. The findings of this study are important for policy makers. One of the main objectives of the current government is Vision 2041 to achieve developed country status by 2041. The government also wants to achieve the SDGs by 2030. Therefore, newly implemented policies and other development programs are linked to these objectives. This study also offers a comprehensive scenario of the existing polytechnics and potential avenues to provide quality technical education for building skilled human resources.

6. Limitation and Further Extension

Although we used a representative sample size from DUET students for this study, they may not represent all private polytechnics across the country. For example, only 6% of students came from private polytechnics, and most come from the same institute each academic year. Therefore, a country-wide study would offer a more comprehensive investigation. Furthermore, this study is the first attempt to examine the effect on private polytechnics in the context of Bangladesh. Therefore, it would be interesting to make an international comparison. Finally, the findings were obtained solely based on the academic success of the polytechnic students. However, some graduates may not pursue higher education; instead, they may pursue professional careers. Therefore, it would be interesting to examine how students of private polytechnics perform in their professional careers compared to their public school counterparts.

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References

1. United Nations Educational, Scientific and Cultural Organization (UNESCO). Learning: The Treasure Within. In *Report to the UNESCO of the International Commission on Education for the Twenty-First Century*; UNESCO: Paris, France, 1998.
2. Cavanagh, D.; Shaw, G.; Wang, L. Technical and vocational education and training, and skills development for rural transformation. *Revisiting Glob. Trends TVET Reflect. Theory Pract.* **2013**, *9*, 309–340.
3. World Bank. What We've Been Reading: How to Improve Technical and Vocational Education and Training for Youth in Developing Countries. World Bank Blog. Available online: https://blogs.worldbank.org/jobs/what-weve-been-reading-how-improve-technical-and-vocational-education-and-training-youth (accessed on 26 March 2021).
4. Naziz, A. Collaboration for transition between TVET and university: A proposal. *Int. J. Sustain. High. Educ.* **2019**, *20*, 1428–1443. [CrossRef]
5. Cruz, M.L.; Saunders-Smits, G.N.; Groen, P. Evaluation of competency methods in engineering education: A systematic review. *Euro. J. Eng. Educ.* **2019**, *45*, 729–757. [CrossRef]
6. Hynes, G.E. Improving employees' interpersonal communication competencies: A qualitative study. *Bus. Prof. Commun. Q.* **2012**, *75*, 466–475. [CrossRef]
7. Mohan, A.; Merle, D.; Jackson, C.; Lannin, J.; Nair, S.S. Professional skills in the engineering curriculum. *IEEE Trans. Educ.* **2009**, *53*, 562–571. [CrossRef]
8. Nair, C.S.; Patil, A.; Mertova, P. Re-engineering graduate skills—A case study. *Eur. J. Eng. Educ.* **2009**, *34*, 131–139. [CrossRef]
9. Alam, G.M.; Forhad, M.; Rahman, A. What makes a difference for further advancement of engineers: Socioeconomic background or education programs? *High. Educ.* **2021**, *83*, 1259–1278. [CrossRef]
10. Alshwayat, D.; MacVaugh, J.A.; Akbar, H. A multi-level perspective on trust, collaboration and knowledge sharing cultures in a highly formalized organization. *J. Knowl. Manag.* **2021**, *25*, 2220–2244. [CrossRef]
11. Martín-de Castro, G.; López-Sáez, P.; Delgado-Verde, M. Towards a knowledge-based view of firm innovation. Theory and empirical research. *J. Knowl. Manag.* **2011**, *15*, 871–874. [CrossRef]
12. Chowdhury, H.; Alam, F. Engineering education in Bangladesh—An indicator of economic development. *Eur. J. Eng. Educ.* **2012**, *37*, 217–228. [CrossRef]
13. Schoen, L.; Fusarelli, L.D. Innovation, NCLB, and the fear factor: The challenge of leading 21st-century schools in an era of accountability. *Educ. Policy* **2008**, *22*, 181–203. [CrossRef]
14. Alam, G.M.; Forhad, M.A.R. Roadblocks to university education for diploma engineers in Bangladesh. *High. Educ. Ski. Work-Based Learn.* **2020**, *11*, 59–77. [CrossRef]
15. Wang, J.; Yang, M.; Maresova, P. Sustainable Development at Higher Education in China: A Comparative Study of Students' Perception in Public and Private Universities. *Sustainability* **2020**, *12*, 2158. [CrossRef]
16. Judson, K.M.; Aurand, T.W.; Gorchels, L.; Gordon, G.L. Building a university brand from within: University administrators' perspectives of internal branding. *Serv. Mark. Q.* **2009**, *30*, 54–68. [CrossRef]
17. Berei, E.B. The Social Responsibility among Higher Education Students. *Educ. Sci.* **2020**, *10*, 66. [CrossRef]
18. Kincaid, A.P.; Sullivan, A.L. Parsing the relations of race and socioeconomic status in special education disproportionality. *Rem. Spec. Educ.* **2017**, *38*, 159–170. [CrossRef]

19. Ware, J.K. Property Value as a Proxy of Socioeconomic Status in Education. *Educ. Urb. Soc.* **2019**, *51*, 99–119. [CrossRef]
20. Lewis, T. Bridging the liberal/vocational divide: An examination of recent British and American versions of an old debate. *Oxf. Rev. Educ.* **1994**, *20*, 199–217. [CrossRef]
21. Bozeman, B.; Corley, E. Scientists' collaboration strategies: Implications for scientific and technical human capital. *Res. Pol.* **2004**, *33*, 599–616. [CrossRef]
22. Li, H.; Loyalka, P.; Rozelle, S.; Wu, B. Human capital and China's future growth. *J. Econ. Perspect.* **2017**, *31*, 25–48. [CrossRef]
23. Graf, L. Applying the Varieties of Capitalism Approach to Higher Education: Comparing the internationalization of German and British universities. *Eur. J. Educ.* **2009**, *44*, 569–585. [CrossRef]
24. Kenny, P.D. The origins of patronage politics: State building, centrifugalism, and decolonization. *Br. J. Political Sci.* **2015**, *45*, 141–171. [CrossRef]
25. Newman, J.H. *The Idea of University Defined and Illustrated*; Oxford University Press: Oxford, UK, 1952.
26. Alam, G.M.; Forhad, A.R.; Ismail, I.A. Can education as an 'International Commodity' be the backbone or cane of a nation in the era of fourth industrial revolution?—A Comparative study. *Technol. Forecast. Soc. Chang.* **2020**, *159*, 120184. [CrossRef]
27. Chowdhury, R.; Sarkar, M. Education in Bangladesh: Changing Contexts and Emerging Realities. In *Engaging in Educational Research*; Springer: Singapore, 2018; Volume 44, pp. 1–18. [CrossRef]
28. Jencks, C.; Smith, M.; Acland, H.; Bane, M.J.; Cohen, D.; Gintis, H.; Heynse, B.; Michelson, S. *Inequality: A Reassessment of the Effect of Family and Schooling in America*; Basic Books: New York, NY, USA, 1972.
29. Marjoribanks, K. *Families and Their Learning Environments: An Empirical Analysis*; Routledge and Kegan Paul: London, UK, 1979.
30. Noël, S.; de Broucker, P. Intergenerational inequities: A comparative analysis of the influence of parents' educational background on length of schooling and literacy skills. In *In Pursuit of Equity in Education: Using International Indicators to Compare Equity Policies*; Hutmacher, W., Cochrane, D., Bottani, N., Eds.; Kluwer Academic: Dordrecht, The Netherlands, 2001; pp. 277–298.
31. Poon, K. The impact of socioeconomic status on parental factors in promoting academic achievement in Chinese children. *Int. J. Educ. Dev.* **2020**, *75*, 102175. [CrossRef]
32. Bos, J.M.; Huston, A.C.; Granger, R.C.; Duncan, G.J.; Brock, T.W.; McLoyd, V.C. *New Hope for People with Low Incomes: Two-Year Results of a Program to Reduce Poverty and Reform Welfare*; ERIC: New York, NY, USA, 1999.
33. McDermott, P.A.; Spencer, M.B. Racial and social class prevalence of psychopathology among school-age youth in the United States. *Youth Soc.* **1997**, *28*, 387–414. [CrossRef]
34. Conger, R.D.; Donnellan, M.B. An interactionist perspective on the socioeconomic context of human development. *Ann. Rev. Psychol.* **2007**, *58*, 175–199. [CrossRef]
35. Mistry, R.S.; Vandewater, E.A.; Huston, A.C.; McLoyd, V.C. Economic well-being and children's social adjustment: The role of family process in an ethnically diverse low-income sample. *Child Dev.* **2003**, *73*, 935–951. [CrossRef]
36. Perry, L.B. Causes and effects of school socio-economic composition? A review of the literature. *Educ. Soc.* **2012**, *30*, 19–35. [CrossRef]
37. Trends, C. Parental Expectations for Their Children's Academic Attainment. 2015. Available online: http://www.childtrends.org/wpcontent/uploads/2012/07/115_Parental_Expectations.pdf (accessed on 4 February 2022).
38. Davis-Kean, P.E. The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *J. Fam. Psychol.* **2005**, *19*, 294–304. [CrossRef]
39. Neuenschwander, M.P.; Vida, M.; Garrett, J.L.; Eccles, J.S. Parents' expectations and students' achievement in two western nations. *Int. J. Behav. Dev.* **2007**, *31*, 594–602. [CrossRef]
40. Triventi, M. Stratification in higher education and its relationship with social inequality: A comparative study of 11 European countries. *Eur. Sociol. Rev.* **2013**, *29*, 489–502. [CrossRef]
41. Tynkkynen, L.; Tolvanen, A.; Salmela-Aro, K. Trajectories of educational expectations from adolescence to young adulthood in Finland. *Dev. Psychol.* **2012**, *48*, 1674–1685. [CrossRef]
42. Kim, E.H.; Flack, C.B.; Parham, K.; Wohlstetter, P. Equity in secondary career and technical education in the United States: A theoretical framework and systematic literature review. *Rev. Educ. Res.* **2021**, *91*, 356–396. [CrossRef]
43. Tarabini, A.; Jacovkis, J. The politics of educational transitions: Evidence from Catalonia. *Eur. Educ. Res. J.* **2021**, *20*, 212–227. [CrossRef]
44. Van der Veen, R.; Datzberger, S. The peacebuilding potential of technical and vocational education and training programmes in post-conflict Sierra Leone. *J. Educ. Policy* **2022**, *37*, 126–144. [CrossRef]
45. Tabbron, G.; Yang, J. The interaction between technical and vocational education and training (TVET) and economic development in advanced countries. *Int. J. Educ. Dev.* **1997**, *17*, 323–334. [CrossRef]
46. Ra, S.; Shrestha, U.; Khatiwada, S.; Yoon, S.W.; Kwon, K. The rise of technology and impact on skills. *Int. J. Train. Res.* **2019**, *17*, 26–40. [CrossRef]
47. Comyn, P.J. Skills, employability and lifelong learning in the Sustainable Development Goals and the 2030 labour market. *Int. J. Train. Res.* **2018**, *16*, 200–217. [CrossRef]
48. Badenhorst, J.W.; Radile, R.S. Poor performance at TVET Colleges: Conceptualising a distributed instructional leadership approach as a solution. *Afr. Educ. Rev.* **2018**, *15*, 91–112. [CrossRef]
49. Yamane, T. *Statistics: An Introductory Analysis*, 2nd ed.; Harper and Row: New York, NY, USA, 1967.

50. Jeffrey, K.; John, K. Managing knowledge work: Specialization and collaboration of engineering problem-solving. *J. Knowl. Manag.* **2004**, *8*, 53–63. [CrossRef]
51. Wang, J.F.J.; Tarn, D.D. Are two heads better than one? Intellectual capital, learning and knowledge sharing in a dyadic interdisciplinary relationship. *J. Knowl. Manag.* **2018**, *22*, 1379–1407. [CrossRef]
52. Gonzalez-Sanchez, M.B.; Gutiérrez-López, C.; Palanca, M.B. How can universities engage lecturers in knowledge transfer? analyzing the influence of performance management systems. *J. Knowl. Manag.* **2022**, *4*, 1083–1110. [CrossRef]
53. Carlyon, T.; Naufahu, M. Academic staff within vocational education responding to learners needs. *Int. J. Train. Dev.* **2022**, *26*, 364–379. [CrossRef]

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Understanding the Push-Pull Factors for Joseonjok (Korean-Chinese) Students Studying in South Korea

Xianghua Cai [1], Donghao Zhang [2] and Yuanying Jin [3,*]

[1] Normal College, Yanbian University, Yanji 133002, China; xhcai@ybu.edu.cn
[2] School of Health in Social Science, University of Edinburgh, Edinburgh EH8 9YL, UK; d.zhang-35@sms.ed.ac.uk
[3] Department of Education, Sejong University, Seoul 05006, Republic of Korea
* Correspondence: yyjin@sejong.ac.kr

Abstract: The factors motivating Joseonjok (Korean-Chinese) students to choose South Korean universities as their study abroad destination have been understudied. In this study, researchers examined the factors that affect Joseonjok students' decision to pursue postgraduate education in South Korea by analyzing interview data collected from 15 Joseonjok graduate students studying at Korean universities using a case study approach. The study identified individual-level, family-level, and national-level push and pull factors motivating Joseonjok students to choose South Korea as their graduate study destination. At the individual level, academic achievement and educational barriers served as push factors, while emotional and ethnic solidarity with Koreans acted as pull factors. On the community level, study abroad trends and immigration patterns among the Joseonjok population were identified as push factors, and the presence of families, relatives, and friends in South Korea served as pull factors. At the national level, push factors included educational policies for minorities in China and fierce competition in higher education entrance exams and the job market. Conversely, national-level pull factors encompassed the 'Study Korea Policy' and policies for overseas Koreans. The current study has implications for policymakers and universities who are planning to recruit international students and educational practitioners intending to provide career counseling and guidance to minority students. Furthermore, we expect the results of the current study to contribute to the sustainable development of higher education in both China and South Korea.

Keywords: Joseonjok; international students; South Korea; study abroad; push-pull factors

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1. Introduction

Education is a stepping-stone to the sustainable development of a nation. Therefore, sustainable education is a crucial concern in both China and South Korea. Sustainable education refers to the delivery of knowledge that encompasses economic, social, and personal aspects, with the ultimate goal of contributing to a balanced national development [1]. As globalization continues to expand and evolve, an increasing number of Chinese students are choosing to study abroad. In 2019 alone, about 703,500 Chinese students pursued higher education degrees abroad. From 1978 to 2019, the total number of Chinese students studying abroad reached 6,560,600 [2]. This trend is driven by heightened competition in the job market and growing demand for higher education in China. However, the country faces a challenge due to limited educational resources. Therefore, studying abroad becomes a compensatory measure, addressing the scarcity of educational opportunities within the country and enabling more Chinese students to receive higher education. Thus, understanding the motivations behind Chinese students' choice to study abroad has significant implications for human resource development and contributes to sustainable national development from the perspective of China. English-speaking countries such as the United States or England are the major destinations for Chinese students. However, in the last 20 years,

Asian countries such as South Korea have become important study-abroad destinations for Chinese students [3,4].

Meanwhile, South Korea's educational system has encountered tremendous challenges recently, threatening its sustainable development. Challenges mainly arise from the shrinking school-age population due to the low birth rate, resulting in many higher educational institutions facing difficulties in recruiting students. For example, the birth rate in 2022 was 0.78, and the total birth population for the year was 249,000 [5]. In contrast, the total number of students taking the Korean College Scholastic Ability Test, which is crucial for college admission, was 509,821 in 2022. Among the participants, 26% (134,834) are students who take the exam more than once [6]. In response to the current circumstance, the Korean government began actively hosting international students via its "Study Korea Project," launched in 2004. This initiative aims to cope with the shrinking school-age population and to globalize its academic institutions [7,8]. Consequently, in 2022, there were about 67,439 Chinese students studying at Korean higher education institutions, representing 40.4% of the total number of international students in South Korea at the time [9]. Given this situation, understanding the motivation of international students to choose South Korea is imperative for the Korean government and institutions to provide a tailored recruiting and support program, ensuring the sustainable development of their educational system.

Among the Chinese student population, there is a special group called the Joseonjok, or Korean-Chinese. Joseonjok refers to an ethnic group of people that have Korean heritage but hold Chinese citizenship. The Joseonjok migrated from the Korean peninsula in the last century due to political and economic causes and acquired Chinese nationality in 1945. When diplomatic relations were formally established between the Republic of China and South Korea in 1992, South Korea started to become a land of opportunity without language barriers where Joseonjok people could pursue financial wealth and potentially realize a better life [10]. As a result, the size of the Joseonjok population in South Korea has expanded dramatically. Of the 804,976 overseas Koreans currently living in South Korea, the Joseonjok population numbers 626,729, which is 77.8% of the total [11]. Most Joseonjok people in Korea are blue-collar workers, and a small proportion of them are white-collar workers and international students.

The "push-pull" model is a frequently cited framework that can explain the reasons why students choose to study abroad. The push-pull model assumes that push and pull factors affect students' decisions to study abroad. In general, push factors operate within the source country, and pull factors operate within the host country [12]. For example, in ref. [12]'s study, the push factors include the assumptions that studying abroad is better than studying in the country, that there will be difficulties in entering a local university, and that students will gain a better understanding of the West by studying abroad, while also accounting for students' plans to migrate after graduation, whereas the pull factors include the reputation of the host country, parental influence, social links in the form of family and friends who live in the host country, the cost of international education, and the local environment. The factors influencing the decision to study abroad occur at many levels and include things such as individual motivation and national marketing [13]. Although the push-pull model provides a comprehensive picture for understanding the reasons for international study, it has been criticized as being overly simplistic. For example, some factors are hard to categorize as either push or pull factors [14].

Meanwhile, extant career theory emerged within the framework of Western cultural paradigms, thereby constraining its applicability to individuals within specific socio-economic contexts. For example, examinations of research trends within articles published in prominent international journals over the preceding 47 years pertaining to the career development of minority or ethnic groups have underscored the existing dearth of comprehensive research on these demographic cohorts. Consequently, prudence is warranted in extrapolating findings from one ethnic group to another [15,16]. In essence, there exists a compelling imperative to undertake targeted career research for distinct ethnic or minority groups to augment the multicultural sensitivity inherent in prevailing career theories.

Previous studies about Joseonjok students in Korea are focused on adjustments to Korean culture [17,18], language [19,20], and identity issues [21,22]. However, there is a dearth of studies that investigate the specific reasons why Joseonjok students decide to study in Korea. In contrast, there have been several studies examining the factors influencing Chinese students' decision to study in Korea. The reasons include the Korean Wave, the relatively inexpensive tuition fees, the proximity between the two countries, and the high admission rate (low institution selectivity) [23–25]. Despite limited evidence from the previous study, it is apparent that ethnic and cultural factors are significant reasons for Joseonjok students choosing a South Korean university. For example, a quantitative study that compared the reasons for choosing Korea as a study abroad destination between the Han ethnic group, the majority ethnic group in China, and the Joseonjok ethnic group revealed distinct factors for the latter, such as "liking Korea," "due to a sense of connectivity," and "fewer language barriers" [26]. Additionally, studies [27,28] also revealed that factors such as using the same language, being comfortable with Korean culture, and having many seniors and friends from the same ethnic group already living in Korea significantly influence Joseonjok students' decision to study in Korea.

Building on these findings, it is presumed that the factors motivating Joseonjok students to study in South Korea might be tied to their unique individual and contextual influences related to their ethnic and cultural traits. As ref. [29] argued, understanding the decision-making process of specific racial or ethnic groups required consideration of cultural-specific factors. This is evident in studies of Chinese-Myanmarese students choosing higher education institutions in China due to geographical proximity, ethnic intimacy, shared ethnic identity, and encouragement from relatives in China [30]. Similarly, overseas Chinese students in Southeast Asia were motivated by factors like ethnic identity, acculturation to Chinese culture, and intimacy born of language and culture [31,32]. Thus, to comprehend why Joseonjok students choose Korea as their study abroad destination, a push-pull framework encompassing individual and contextual factors is needed.

The aim of the current study is to comprehensively investigate the factors motivating Joseonjok students to study in South Korean universities. To achieve the research purpose, a case study approach, a qualitative study method suitable for investigating the subjective experiences of participants deeply and answering "why" and "how" research questions in a real-world context [33], was applied. We adopted a case study methodology, specifically employing a qualitative approach, due to the limited scope of comprehensive investigations on this subject. The extant research primarily centered on the comparative analysis of motivations for selecting a Korean university among Han ethnic students and Joseonjok students, utilizing a quantitative methodology [26]. Other inquiries within this domain have focused on investigating the transnational immigration patterns of the Joseonjok younger generation [27]. Additionally, a distinct investigation delved into the perspectives of Joseonjok students regarding South Korea [28]. However, a direct and exhaustive exploration into the factors influencing Joseonjok students' choice of Korea as their study destination has not yet been conducted. In the absence of a theoretical framework and antecedent studies, the utilization of a qualitative study to probe profoundly into the intricacies surrounding this phenomenon proves advantageous.

We anticipate that the results of this study will serve as an essential resource for policymakers and universities planning to recruit international students and educational practitioners providing career counseling and guidance to minority students. Furthermore, we expect the results of the current study to contribute to the sustainable development of higher education in both China and South Korea.

The research question in this study was: Why do Joseonjok students from China choose South Korea as their study-abroad destination?

2. Methods

2.1. Participants

Using the snowball sampling method [34], researchers recruited and interviewed 15 Joseonjok graduate students for this study. Of them, 11 were women, and four were men, with ages ranging from the mid-20s to the early 40s. Their academic majors were evenly divided among the humanities, sciences, and social studies. Most of them originated from three northeast provinces of China, and all participants, except three, had been studying in a Korean-Chinese secondary school in China. The years of stay in South Korea ranged from 1 year and 7 months to 17 years and 7 months. Demographic information of participants is presented in Table 1.

Table 1. Demographic Information of Participants.

No.	Gender	Age	Major	Place of Birth	Type of School	Length of Stay
1	Female	25	Nutritional Science	Liao Ning	Joseonjok school	1 year 7 months
2	Female	31	Nursing	Hei Long Jiang	Joseonjok school	5 years 6 months
3	Female	32	Nanotechnology Engineering	Ji Lin	Joseonjok school	8 years
4	Male	32	Law	Ji Lin	Joseonjok school	2 years
5	Male	26	Media Communication	Ji Lin	Joseonjok school	3 years 2 months
6	Female	25	Social Welfare	Ji Lin	Joseonjok school	2 years 7 months
7	Female	27	Nursing	Ji Lin, Shang Dong	Chinese School	2 years 8 months
8	Female	42	Counselor Education	Ji Lin	Joseonjok school	17 years 7 months
9	Male	30	Psychology	Ji Lin	Joseonjok school	7 years 3 months
10	Female	27	Human Resources	Ji Lin	Joseonjok school	1 year 6 months
11	Male	30	Synthetic Biology	Ji Lin	Joseonjok school	6 years 3 months
12	Female	34	Synthetic Biology	Hei Long Jiang	Chinese school	4 years 10 months
13	Female	34	Environmental Planning	Ji Lin	Joseonjok school	5 years 2 months
14	Female	37	Translation and Interpretation Studies	Ji Lin	Joseonjok school	12 years 8 months
15	Female	30	Engineering	Hei Long Jiang	Chinese school	10 years 8 months

2.2. Protocol Development

We developed semi-structured interview questions with the aim of best serving the research purposes. The main interview questions were 'What have you experienced in the process of coming to Korea?' and 'What factors influenced your decision to come here?' More specifically, we asked participants questions such as 'How did you come to Korea?' and 'What difficulties have you experienced in the process of choosing Korea, and how have you overcome them?'. Additionally, we inquired about 'what (environment, person, event, happenstance, etc.) helped you come here?'. We posed these open-ended questions to allow participants to explore their experiences deeply.

2.3. Data Analysis

The inductive analysis approach, which is a bottom-up approach, was applied in data analysis [35]. Specifically, the current data applied the pattern-matching method proposed by [33]. Interview data was transcribed into text first. Then, categories and themes emerged from the data through open coding. Lastly, using the constant comparative method [36], we frequently went back to the raw data to compare observed patterns with expected patterns and finally created matched patterns.

2.4. Validity and Reliability

To improve the validity and reliability of the study, we assessed the data using the standards proposed by [37]: credibility, fittingness, and auditability (or confirmability). Specifically, to confirm credibility, we used open-ended questions to elicit experiences from participants via individual interviews. The interviews were recorded and transcribed line by line, and the data was used in the analysis. Furthermore, we adopted a member check process to ensure that the content and analysis of the interviews truly reflected the ideas of the participants. In addition to the interview data, we used various data sources, including observation records, researchers' memos, and related literature, to validate the results. To ensure suitability, we arranged short meetings during the recruiting process to screen the participants and attempted to recruit individuals who had experienced the phenomena that are the focus of the current study and who could freely articulate their own experiences. To guarantee the auditability of the study, we asked two researchers with doctoral degrees in counseling and experience in conducting research on the topic of the Joseonjok people to verify the research results and provide feedback. To minimize bias, we consulted a supervisor and the aforementioned two researchers. Through the above process, we tried to achieve confirmability by setting aside any preconceived ideas and looking at participants' own experiences within their real-world context.

3. Results

The current study identified four individual-level factors, four community-level factors, and four national-level factors for Joseonjok students, which are listed in Table 2.

Table 2. Push-Pull Factors for Joseonjok Students by Level.

Level	Push Factors (China)	Pull Factors (South Korea)
Individual	Academic achievement Educational barriers	Emotional solidarity with Koreans Ethnic solidarity with Koreans
Community	Study abroad trend Immigration trend among the Joseonjok population	Families and Relatives in Korea Friends in Korea
National	Educational policy for minorities in China Fierce competition in higher education entrance exams and the job market	Study Korea Policy Policy for Overseas Koreans

3.1. Individual-Level Push-Pull Factors

Individual push factors include the prospect of academic achievement and a dedication to developing more advanced abilities, as well as the barriers participants faced in preparing for graduate school admission at Chinese universities. Participants noted the prevalence of higher education in China and that receiving a postgraduate education is important to secure their future careers. Furthermore, they believed they would have a greater chance of being admitted to prominent Korean universities, where they could receive a quality education, than to universities in China.

> **Participant 10:** There are so many people who have a bachelor's degree in China. I do think it is helpful in some way if you possess a higher degree. . . If you are equipped with professional knowledge, it will help you find a better career, and it will also be good for your future development.

> **Participant 4:** I think the admission rate at South Korean universities is high, and one could have more chances to enter top-ranked universities here. So, this is a better place to develop my abilities and learn more things.

The main obstacle faced by participants in gaining admission to graduate schools in China is the language barrier, which is also connected to the academic challenges they encountered during their undergraduate studies. A significant number of Joseonjok students are bilingual, with Korean being their first language. Consequently, they feel that

they lack competitiveness in the demanding graduate school entrance exams conducted in Chinese.

> **Participant 13:** I graduated from a Joseonjok high school and went to undergraduate school in Beijing. While studying there, I experienced many difficulties due to the language barrier. I considered preparing for graduate school in China, but when I saw the vast amount of material I needed to remember in Chinese, I thought I had little chance of passing the exam. I felt I was not competitive enough compared to other Chinese students whose mother tongue is Chinese.

Participants said they felt an emotional connection and a sense of closeness to Korea due to sharing the same ethnic background with people in South Korea.

> **Participant 4:** Korea is a country where I can go anytime. It is a very comfortable place for me compared to other countries. People there speak the same language as I do, and they are of the same ethnicity.

Participants reported that having a similar cultural background to the host country and speaking the same language were also important pull factors. They anticipated that they could adjust to life and study in Korea better than if they studied in other countries.

> **Participant 6:** Because of the language convenience, I can understand the lessons well, and I am also familiar with Korean culture, so I thought I might experience fewer difficulties in studying and living in Korea.

3.2. Community-Level Push-Pull Factors

Pursuing a foreign degree has become commonplace for Chinese students. As a result, Joseonjok students also consider studying abroad to be important to their careers. With an increasing number of Joseonjok students choosing to study in Korea, they have begun to contemplate the advantages of studying in Korea and perceive it as a place where they can realize their self-worth.

> **Participant 1:** There were many people studying abroad around me, and some of them chose Korea. I heard stories of those who had the experience of studying abroad and started to think about going myself. I thought if I received a graduate degree in another country, my self-worth could increase.

Universities in Yanbian Korean Autonomous Prefecture, the home of the majority of China's Joseonjok population, have built relationships with universities in Korea due to their shared geographic and ethnic characteristics. Some students from the area have been given the chance to study at Korean universities thanks to tuition waivers or scholarships, courtesy of their connections with Korean professors. This highlights the heightened accessibility of Korean universities for Joseonjok students.

> **Participant 8:** I graduated from a university in the Yanbian area, and many universities there have established partnerships with Korean universities. We can easily get admission thanks to tuition waivers from Korean universities, so many students from our school are studying at Korean universities. In my case, I went to a Korean university as an exchange student when I was a college senior and I had a really good experience there.

Many young people in Yanbian have left home because of the economic downturn and high unemployment rate in the area. This has also become an important factor that facilitates the decision to study in Korea. While observing friends and seniors around them settling down in new places where they can develop and explore better careers, participants said they realized that they should take a risk and explore their careers while living beyond their comfort zone.

> **Participant 9:** In China, you always need to start over as long as the place you choose to live is not your hometown. . . My hometown is a small city, with few opportunities, so many of my friends would rather go to big cities like Shanghai

> or Beijing, or even to Korea... Most of them are trying to find a new foundation for their lives.

The immigration of relatives and friends to Korea made participants feel comfortable with Korea and gave them positive expectations of the country. Some participants live with or can often see parents who already reside in Korea. Others received practical help while settling down in Korea from relatives who came to Korea before them.

> **Participant 11:** My parents live in Korea now. I had thought that if I stayed in China, I wouldn't be able to see them often, but since I'm studying in Korea, I can live close to them and contact them more often. I think this is an important factor that affected my decision to come to Korea to study.

> **Participant 11:** For many Joseonjok students, having relatives living in Korea proves beneficial. They can initially live with their relatives when they first arrive, which helps them adjust well to their studies and life in Korea.

It seems that the help and suggestions from friends who have experience studying in Korea played an important role in the participant's decision to study there, too. Participants drew on the experiences of friends as essential resources and received practical help in applying to Korean universities and moving to Korea.

> **Participant 1:** If I had decided to go to the United States, I might have had no clue. With Korea, I have friends and seniors who are already here, so I asked them a lot of questions. They told me that I needed to take the TOPIK (Test of Proficiency in Korean), and I thought the exam wouldn't be a big problem for me, so I felt it was possible for me to gain (graduate school) admission.

> **Participant 6:** One of my seniors, who already graduated from a Korean university, gave me a lot of help, such as what I should prepare during the application process, how to fill in the application form, how long the whole process would take, and so on.

3.3. National-Level Push-Pull Factors

Under China's educational policy for minorities, Joseonjok students are able to preserve their own culture and use their own language. However, this results in a gap between Joseonjok students and other Chinese students in terms of language, culture, and education, eventually leading Joseonjok students to face many difficulties in preparing for graduate school in China.

> **Participant 11:** Chinese students have many chances to learn Chinese culture and history from the environment they live in and their parents from childhood, and they only need to study Chinese and English. I lived in the Yanbian area, and I went to a Joseonjok school. At the school, I took Korean courses, and I learned about the immigrant history of the Joseonjok population. I have been speaking Korean since childhood. There is an educational gap between Chinese and Joseonjok students.

Perceived difficulties in pursuing graduate school in China, as well as the fierce competition in higher education entrance exams and the job market, directly affect participants' confidence and their perceived competitiveness, leading them to believe that they should improve their competence by studying abroad.

> **Participant 13:** It is hard to find a good job with only a bachelor's degree in China because there are so many people who even have master's degrees. If I want to compete with them, I need to learn more to acquire more competence.

Korean universities are more accessible for Joseonjok students than universities in English-speaking countries. Korean universities provide a special track for international students where the only requirement is a document screening, and Joseonjok students can benefit from this policy. Additionally, Joseonjok students can easily receive a Korean

language certificate for applying to Korean universities. If Joseonjok students choose to go to an English-speaking country, language, and financial issues can be barriers.

> **Participant 3:** If we choose to go to an English-speaking country to study further, we probably need to study the language for one or two years. . . In order to get into a Korean university, we just have to submit a language certificate. For us, a Korean language certificate is not a problem, so it is not that difficult to come here. . . If we plan to go to graduate school in China, we have to take an entrance exam, but here in Korea, we can apply through the special track for foreigners. Korea also has many scholarship programs, so these are big advantages for us to come here to study.

Korea's immigration policy for overseas Koreans has done much to facilitate Joseonjok students' study and settlement in Korea. Many Joseonjok students who apply for a Korean visa with a bachelor's degree qualify for the overseas Korean visa (F-4) rather than the international student visa (D-2). The process of applying for and renewing the F-4 visa is remarkably convenient and straightforward, making living and working in Korea significantly easier compared to doing so with an international student visa. As a result, this policy provides numerous benefits to Joseonjok students, enabling them to study in Korea and eventually pursue employment and settle down in the country after completing their studies.

> **Participant 5:** For Joseonjok students, if they have a bachelor's degree, they can apply for the F-4 (overseas Korean visa). People who have the international student visa (D-2) need to extend their visa every year and it is inconvenient. However, with the F-4 visa, it only needs to be extended every three years, allowing us to live here for a long time as long as we get our visa extended. Moreover, we can apply for different kinds of jobs here freely with the F-4 visa.

4. Discussion

This study aimed to examine the experiences of Joseonjok students who chose South Korea as their study abroad destination using a case study approach. The distinctive push-pull factors for Joseonjok students were identified. In this section, we will discuss the results in comparison to Chinese students and other minority students.

4.1. Comparisons to Chinese Students

This study identified academic achievement, barriers to further education, the trend toward studying abroad, and the competitive academic and employment environment as push factors for studying abroad. These factors have also been identified in previous research on Chinese students and duplicate the results of ref. [38]'s research, which asserted that personal motivations, such as academic achievement, improving competitiveness in the job market, and social mobility, have a significant impact on a person's decision to study abroad. In particular, for graduate students, having a clear goal for the future has been identified as an important factor [39] in their decision to study abroad. In recent years, there has been an increasing demand for higher education among Chinese students in China due to the intensely competitive job market, leading to a mismatch between the supply of higher education and the demand for it [40–42]. This discrepancy has also resulted in intensified competition for graduate school admission, which has become an important factor driving many Chinese students to pursue education abroad [43,44].

Aside from that, this study found that Joseonjok students are influenced by different push factors than Chinese students, such as the trend among the Joseonjok population toward immigration to South Korea and the educational policy for minorities in China. Since the implementation of the Open Door Policy in China, a significant proportion of the Joseonjok population has migrated to South Korea. According to the [45], more than 42% of the total Joseonjok population (1,702,479) is residing in South Korea. It has been

found that the decisions of Joseonjok students to study abroad in South Korea are highly influenced by their parents and friends' settlement in South Korea [28,46].

China's educational policy for minorities is implemented within a unified education system. Under the policy, minority students are allowed to receive ethnic studies education to preserve their cultural heritage. However, this means that minority students experience differences in educational resources compared to mainstream Han Chinese students. In particular, many minority students primarily use their ethnic language during childhood, so they might not be as proficient in Chinese as their Han Chinese peers [47]. The fact that minority students must study and take exams in Chinese might affect their self-efficacy in pursuing graduate education [48]. As a result, the perceived barriers to pursuing graduate education among Joseonjok undergraduate students might be greater due to language limitations, and this could play a significant role in their decision to study abroad.

On the other hand, the study highlighted the significance of friends in South Korea, along with the impact of the country's recruiting policies for international students (e.g., Study Korea Policy), as key pull factors influencing the choice of South Korea as a study destination for Chinese students, including Joseonjok students. Both Chinese and Joseonjok students highly regard the advice of parents and friends as influential in their career decisions [41], so, like other Asian students, they often seek guidance from family and friends during the career decision-making process [49]. Furthermore, previous research has shown that Chinese students are drawn to Korea for its lax admission process, which is seen as an advantage over Western universities [50].

Significantly, Joseonjok students are influenced by unique factors when deciding to study in Korea, including emotional and ethnic solidarity with Korean citizens, the settlement of families and relatives in Korea, and the national immigration policy for overseas Koreans. This sharply contrasts with the findings of previous research on Chinese students, where factors such as geographical proximity, affordable tuition fees, and the influence of the Korean Wave (Hallyu) were identified as the main pull factors for studying in South Korea [23–25]. In particular, the ethnicity factor plays a significant role in Joseonjok students' decision to study in Korea, which is consistent with earlier studies [26,28]. On the other hand, lifestyle differences, language barriers, and other factors contribute to Chinese students' reluctance to consider studying abroad [51].

Previous research supports the idea that the desire to live with parents or siblings who are already living or working in Korea can be a crucial factor for Joseonjok students when deciding whether to study in South Korea [52]. Furthermore, Joseonjok students benefit from policies for overseas Koreans, such as the F-4, due to their status as ethnic Koreans, which have a positive influence on their decision to study in Korea. This is in stark contrast to Chinese students' decisions to study in Korea, where visa policies ranked only 10th as a significant factor [53].

4.2. Comparisons to Other Minority Students

The distinctive factors identified in this study are partially supported by previous research on ethnic minorities and the overseas Chinese population. According to previous studies, factors such as kinship-based intimacy, the influence of relatives in the study-abroad country, and ethnic and cultural familiarity have persuaded members of China's overseas ethnic minorities and overseas Chinese population to choose China as their study-abroad destination [30–32].

However, this study shows that the trend toward immigration among the Joseonjok population, China's minority education policies, and Korea's policies for overseas Koreans, primarily the F-4 visa, have a significant influence on Joseonjok students' decision to study in Korea. This can be understood by considering the characteristics of China's minority education policies, Korea's national strategy to utilize diasporic Koreans as valuable resources, and the complex interaction between the economic development of the Joseonjok autonomous region in northeastern China and the high aspirations of the Joseonjok community.

In a broader context, the factors elucidated in this study exhibit parallels with those influencing Chinese students in their choice of Korea. Nevertheless, a noteworthy disparity observed among Joseonjok students, in contrast to their Chinese counterparts, pertains to 'ethnicity', encompassing the salience of emotional and ethnic solidarity, policies for minorities in China, and policies for overseas Koreans in South Korea. In consonance with antecedent investigations on minority or ethnic cohorts, considerations associated with 'ethnicity' emerge as substantive determinants influencing Joseonjok students in opting for South Korea. This implies that 'ethnicity' assumes a pivotal role in shaping their career decision-making process.

4.3. Theoretical and Practical Implication

In contemporary discourse, prevailing career theories derived from Western cultural foundations have encountered criticism for their perceived inadequacy in demonstrating cultural sensitivity when applied to distinct minority or ethnic groups [15,16]. The present study directs its focus toward Joseonjok students, who have been nurtured within Eastern cultural contexts, with the aim of enhancing comprehension of multicultural career theory. More specifically, it broadens the application of social cognitive career theory to minority groups. Unlike traditional career theory, which underscores individual influences in the career decision-making process, social cognitive career theory advocates for the integration of individual, environmental, and contextual factors to enhance explanations in career decision-making [54]. Through an examination of contextual support and barriers in career choice, the current study implies the relevance of the theory to minority groups, such as Joseonjok. Moreover, the results of the current study extend the existing push-pull model by delving into various levels of push-pull factors.

Additionally, the Joseonjok community, constituting a minority in China and sharing historical roots with Korea, assumes a consequential role in facilitating exchange between the two nations. Acknowledging the pivotal significance of human capital in national development, both countries are committed to the reception and nurturance of distinguished talents. Within this framework, the career decisions of Joseonjok students, specifically those at the graduate level, hold relevance for the mutual advancement of both nations. Consequently, the present study contributes empirical evidence that buttresses the strategic development of human resources for both countries. More specifically, the study yields two practical implications. First, gaining insights into the pull factors for Joseonjok students equips the Korean government and institutions with the means to devise tailored policies to attract and support international students. For instance, the South Korean government could institute a cultural program emphasizing emotional and ethnic solidarity with Koreans for Joseonjok students or provide various policy benefits to facilitate their settlement in Korea after graduation. Second, understanding push factors holds practical implications for the Chinese government to enact policies preventing the loss of human resources. For example, the existing educational policy for minorities, while beneficial for maintaining cultural heritage, simultaneously creates an educational gap between the mainstream and minorities. Consequently, the current study serves as a catalyst for the Chinese government to contemplate strategies for preserving cultural heritage while concurrently enhancing minority educational competence.

4.4. Limitations

This study has limitations in terms of the research subjects and their background, necessitating careful consideration of the following points in future research. First, the study subjects are Joseonjok graduate students who were born, educated, and raised in China's three northeastern provinces, which are the primary settlement areas for the Joseonjok population. Therefore, there are limitations in applying the results of this study to Joseonjok students who grew up in environments with a different educational system and linguistic backgrounds. Moreover, there might be some differences in the study abroad decisions of undergraduate and graduate students [51]. Thus, the findings of this study can be used as

a reference for understanding the career decision factors of Joseonjok students who pursue undergraduate studies in Korean universities, but further research is needed. Second, since 2017, China's emphasis on "Chinese national community consciousness" and the Chinese government's implementation of the "National Common Language and Writing Law" in 2019 can be viewed as national strategies for its transformation into a modernized socialist country with Chinese characteristics, aimed at enhancing national unity and cohesion. These policy trends bring new challenges to the existing social and educational environments for minority groups and require changes in Joseonjok society, families, and individuals. Therefore, the results of this study on Joseonjok students who have grown up under the current minority educational policies need to be carefully examined in future research on the factors influencing Joseonjok students' decisions to study abroad. In other words, future research on Joseonjok students' study abroad decisions must adequately consider the changes in the existing national, social, and cultural contexts.

5. Conclusions

While studies, such as ref. [55], have underscored the impact of both external and internal factors on international student mobility, previous research on career decision-making, encompassing the choice to study abroad across diverse ethnic groups, has consistently emphasized the importance of sociocultural contexts and environmental influences [56,57]. Despite these insights, there has been a noticeable gap in existing literature regarding international students' study abroad decisions, with insufficient attention given to the intricate interplay of multiple factors across various levels. In response to this gap, the present study takes a novel approach by analyzing the push and pull factors influencing Joseonjok students' decisions to study in South Korea at three distinct levels: individual, community, and national. Particularly, within this array of factors, 'ethnicity'—encompassing emotional and ethnic solidarity with South Korea, educational policies tailored for minorities in China, policies pertaining to overseas Koreans, and familial connections in South Korea, among others—emerged as a salient consideration, distinctly divergent from the considerations of Chinese international students.

Furthermore, this study holds significance from both China's and Korea's perspectives. It provides valuable insights for China in developing strategies to prevent the loss of Joseonjok human resources while offering South Korea opportunities to enhance the entry and integration of diasporic Koreans. From an educational standpoint, the findings of this study are anticipated to make substantial contributions by guiding career decisions and counseling approaches that genuinely consider the cultural and ethnic characteristics of minority students. Ultimately, the study is expected to contribute to sustainable higher education in both China and South Korea.

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References

1. Sterling, S. Sustainable Education Revisioning Learning and Change, Schumacher Briefing no6. In *Schumacher Society/Green Books*; Dartington: Totnes, UK, 2001.
2. Ministry of Education of the People's Republic of China. Statistics of Overseas Study Students in 2019. 2020. Available online: http://www.moe.gov.cn/jyb_xwfb/gzdt_gzdt/s5987/202012/t20201214_505447.html (accessed on 22 August 2023).
3. Lu, G.S.; Tian, M.; Lai, M.H. Analysis of factors influencing college students' intention of pursuing postgraduate study abroad. *Fudan Educ. Forum* **2014**, *5*, 36–44.
4. Zhang, L.S.; Wei, L.L.; Zhu, L.; LI, Z.H. A Study on the factors impacting the university choice and decision making for studying abroad. *Mod. Educ. Manag.* **2021**, *11*, 113–119.
5. Statistics Korea. Birth Statistics for 2022. 2002. Available online: https://kostat.go.kr/board.es?mid=a10301010000&bid=204&list_no=426806&act=view&mainXml=Y (accessed on 1 December 2023).
6. Korea Institutes for Curriculum and Evaluation. Yearly Exam Application Status. 2022. Available online: https://www.suneung.re.kr/sub/info.do?m=0404&s=suneung (accessed on 1 December 2023).
7. Ministry of Education. Establishment of Comprehensive Strategies to Expand Recruitment of Foreign Students for Overseas Human Resources Development (Study Korea Project). 2004. Available online: http://img.yonhapnews.co.kr/etc/press/PR/2004/%EB%B3%B4%EB%8F%84%EC%9E%90%EB%A3%8Ch20041206023.pdf (accessed on 1 August 2023).
8. Ministry of Education. Study Korea 2020 Project Implementation Plan ('13~'20). 2012. Available online: https://www.moe.go.kr/boardCnts/viewRenew.do?boardID=294&lev=0&statusYN=C&s=moe&m=020402&opType=N&boardSeq=38102 (accessed on 20 January 2023).
9. Ministry of Education. 2022 Education Basic Statistics. 2022. Available online: https://kess.kedi.re.kr/index (accessed on 1 August 2023).
10. Li, M.H. Status and prospect: A research review on Korean Chinese transnational migration-centered on Chinese Academia. *J. Humanit. Unificat.* **2015**, *61*, 501–522. [CrossRef]
11. Ministry of Justice, Korea Immigration Service. Annual Status of Overseas Koreans of Different Nationalities. 2022. Available online: https://www.moj.go.kr/moj/2414/subview.do (accessed on 24 August 2023).
12. Mazzarol, T.; Soutar, G.N. "Push-pull" factors influencing international student destination choice. *Int. J. Educ. Manag.* **2002**, *16*, 82–90. [CrossRef]
13. Zhang, Y.; O'Shea, M.; Mou, L. International students' motivations and decisions to do a PhD in Canada: Proposing a three-layer push-pull framework. *Can. J. High. Educ.* **2021**, *51*, 61–73. [CrossRef]
14. Chen, J.M. Three levels of push-pull dynamics among Chinese international students' decision to study abroad in the Canadian context. *J. Int. Stud.* **2017**, *7*, 113–135. [CrossRef]
15. Flores, L.Y.; Berkel, L.A.; Nilsson, J.E.; Ojeda, L.; Jordan, S.E.; Lynn, G.L.; Leal, V.M. Racial/ethnic minority vocational research: A content and trend analysis across 36 years. *Career Dev. Q.* **2006**, *55*, 2–21. [CrossRef]
16. Lee, B.H.; Zhu, J.; Diaz, D.; Fischer, J.; Flores, L.Y.; Lin, C.L.; Beilgard, J.; May, S.; Munoz, M.; Shahin, M.; et al. Racial/ethnic minority vocational research trends: An 11-year update. *Career Dev. Q.* **2017**, *65*, 288–301. [CrossRef]
17. Ha, C.S.; Seon, H.Y. A comparative study on the stress coping style of Korean, Korean-Chinese and Chinese college students studying in South Korea. *J. Hum. Underst. Couns.* **2010**, *31*, 317–328.
18. Kim, M.K.; Han, J.S. Study on Korean Chinese and Han Chinese international students' adaptation process in Korea. *Cult. Exch. Multicult. Educ.* **2013**, *2*, 5–24.
19. Quan, Y. A study on identity based on language use and experiences of Korean-Chinese undergraduate and graduate students: Focusing on the ideological becoming based on Bakhtin's dialogism. *Biling Res.* **2021**, *83*, 181–211.
20. Zhuo, J. A Qualitative Study about Language Problems on Learning Process of Chinese-Korean International Graduate Students at the Living in Korea. Master's Thesis, Hanyang University, Seoul, Republic of Korea, 2018.
21. Jin, Y.Y.; Kim, B.R. Ethnic identity issues of the highly educated Korean Chinese in South Korea: A study on the Korean Chinese mainly from Yanbian area. *Stud. Koreans Abroad* **2019**, *49*, 35–70. [CrossRef]
22. Piao, J.H.; Piao, J.H. Between ethnics and nationals: Korean Chinese transnational migration and identical conflict. *Korean Stud.* **2015**, *39*, 449–482.
23. Kong, Q.; Cui, J.H. Study on the motivation of Chinese students studying in Korea. *Educ. Teach. Forum* **2019**, *16*, 61–62.
24. Lee, J. China's minority policy and the identity of the Korean diaspora. *Korean J. Political Sci.* **2017**, *25*, 81–106. [CrossRef]
25. Shang, N. Analysis of decisive factors in studying in South Korea based on Push-Pull model. *Guide Sci. Educ.* **2021**, *9*, 16–18.
26. Piao, Y. A study on migration and characteristics of Chinese foreign students in Korea: Focusing on the comparison between Han and Korean Chinese students. *Stud. Koreans Abroad* **2009**, *19*, 155–181.
27. Lee, H. The characteristics of transnational migration of young white-color Joseonjok. *J. Diaspora Stud.* **2013**, *7*, 103–129.
28. Zhang, X. A Study on the Perception of Korea by Korean-Chinese Students Studying in Korea. Master's Thesis, Ewha Womans University, Seoul, Republic of Korea, 2010.
29. Leong, F.T.L.; Gupta, A. Theories in cross-cultural contexts. In *International Handbook of Career Guidance*; Athanasou, J., Van Esbroeck, R., Eds.; Springer: Berlin/Heidelberg, Germany, 2008; pp. 227–248.

30. Wang, Y.L.; Su, P. Analysis of the influencing factors of cross-border admission of Burmese students in Yunnan area of Sino-Burmese border: Based on the survey of Dai-Jingpo autonomous prefecture of Dehong. *J. Res. Educ. Ethn. Minor.* **2018**, *3*, 87–93.
31. Chen, W.; Li, Z.; Deng, Y. Motive analysis of studying of southeast Asian young people of ethnic Chinese in China—Basing on the data from sampling survey and field research in 15 colleges of Guangdong and Guangxi. *J. World Peoples Stud.* **2013**, *4*, 56–62.
32. Chen, Y.R. Intellect and affect: Interpreting the study—In-China motivation of southeast Asian students of Chinese Origin. *Overseas Chin. Educ.* **2006**, *3*, 41–46.
33. Yin, R.K. *Case Study Research: Design and Methods*; Sage: Thousand Oaks, CA, USA, 2009; Volume 5.
34. Merriam, S.B. *Qualitative Research: A Guide to Design and Implementation*, 2nd ed.; Jossey-Bass: San Francisco, CA, USA, 2009.
35. Lincoln, Y.S.; Denzin, N.K. *Turning Points in Qualitative Research: Tying Knots in a Handkerchief*; Rowman Altamira: Lanham, MD, USA, 2003; Volume 2.
36. Strauss, A.; Corbin, J. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, 2nd ed.; Sage: Thousand Oaks, CA, USA, 1998.
37. Sandelowski, M. The problem of rigor in qualitative research. *Adv. Nurs. Sci.* **1986**, *8*, 27–37. [CrossRef] [PubMed]
38. Park, E.K. A Study on international migration of foreign students and their adaptation to local community: Focusing on Daegu/Gyeongbuk area. *Contemp. Soc. Multicult.* **2011**, *1*, 113–139.
39. Lin, N. A Qualitative Study of Chinese Students' Socio-Cultural Adaptation to Korean Life. Master's Thesis, University of Seoul, Seoul, Republic of Korea, 2012.
40. Davey, G. Chinese students' motivations for studying abroad. *Int. J. Priv. Educ.* **2005**, *2*, 16–21. [CrossRef]
41. Yang, M. What attracts mainland Chinese students to Australian higher education? *Stud. Learn.* **2007**, *4*, 1–12.
42. Zhao, J.; Guo, J. The restructuring of China's higher education: An experience for market economy and knowledge economy. *Educ. Philos. Theory* **2002**, *34*, 207–221. [CrossRef]
43. Li, Q.; Sun, Y.M. An understanding and reflection on the four trends of Chinese university students studying abroad. *J. Beijing Adm. Inst.* **2018**, *5*, 93–100.
44. Liu, H.X.; Fang, J.X. Research on new generation college students' motivation to study abroad: In-depth interviews of 7 college students preparing study abroad in Beijing. *China Youth Study* **2011**, *7*, 86–89.
45. Seventh National Population Census of China. China Population Census Yearbook 2020. 2020. Available online: http://www.stats.gov.cn/sj/pcsj/rkpc/7rp/zk/indexch.htm (accessed on 25 August 2023).
46. Lee, K.H.; Chung, K.S.; Yoo, M.K.; Jung, K.M. Feminization of migration and transnational families of Korean-Chinese migrants in South Korea. *Korean J. Sociol.* **2006**, *40*, 258–298.
47. Wang, Z.J.; Li, H.P. Why minority college students have difficulties in learning: A grounded theory analysis of Xinjiang Uyghur students at Z university. *Renmin Univ. China Educ. J.* **2020**, *3*, 5–20.
48. Luo, Y.Y.; Yang, L.; Shen, L.J. Analysis of post-graduate entrance anxiety and related factors among college students. *Chin. J. Sch. Health* **2010**, *31*, 1510–1511.
49. Singaravelu, H.D.; White, L.J.; Bringaze, T.B. Factors influencing international students' career choice: A comparative study. *J. Career Dev.* **2005**, *32*, 46–59. [CrossRef]
50. Lee, S.W. Circulating east to east: Understanding the push–pull factors of Chinese students studying in Korea. *J. Stud. Int. Educ.* **2017**, *21*, 170–190. [CrossRef]
51. Zhai, Y.Q.; Xue, C.H.; Wang, X.S.; Chao, X.; Guo, Y.X.; Sun, Z.A. A survey of college students' intentions and suggestions on studying abroad in local universities in China: Take N university in S province as an example. *High. Educ. Sci.* **2018**, *4*, 60–68.
52. Moon, H.J. Comparative study of the acculturation of Chinese International Students (Han Chinese-Korean Chinese) to Korean Culture. *Soc. China Cult. Korea* **2013**, *39*, 155–176.
53. Kang, R.L.; Ko, J.W. An analysis of factors influencing Chinese students' decisions to study in Korea: Focusing on pull factors in the push-pull theory. *J. Educ. Cult.* **2019**, *25*, 1075–1097.
54. Lent, R.W.; Brown, S.D.; Hackett, G. Contextual supports and barriers to career choice: A social cognitive analysis. *J. Couns. Psychol.* **2000**, *47*, 36–49. [CrossRef]
55. Li, M. *The Global Flows of Chinese Students: International Markets for Higher Education*; Shanghai Education Press: Shanghai, China, 2008.
56. Hartung, P.J. Cultural context in career theory and practice: Role salience and values. *Career Dev. Q.* **2002**, *51*, 12–25. [CrossRef]
57. Young, R.A.; Marshall, S.K.; Valach, L. Making career theories more culturally sensitive: Implications for counseling. *Career Dev. Q.* **2007**, *56*, 4–18. [CrossRef]

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Academia-Industry Linkages for Sustainable Innovation in Agriculture Higher Education in India

Sudhir Kumar Soam [1,*], Yashavanth Basavapatna Subbanna [1], Surya Rathore [1], V. Venkata Sumanth Kumar [1], Sanjiv Kumar [1], S. Senthil Vinayagam [1], S. Rakesh [1], Raghupathi Balasani [1], Dhumantarao Thammi Raju [1], Alok Kumar [1], Nukella Srinivasa Rao [1], Pandian Krishnan [2], Sudeep Marwaha [3], Anuradha Agrawal [4], Cherukumalli Srinivasa Rao [1] and Rakesh Chandra Agrawal [4]

[1] ICAR—National Academy of Agricultural Research Management, Hyderabad 500030, India; suryarathore@naarm.org.in (S.R.); sumanth@naarm.org.in (V.V.S.K.); senthil@naarm.org.in (S.S.V.); srakesh.nahep@naarm.org.in (S.R.); dtraju@naarm.org.in (D.T.R.); alok@naarm.org.in (A.K.); ns.rao@naarm.org.in (N.S.R.); chsrao_director@naarm.org.in (C.S.R.)
[2] Bay of Bengal Programme, Chennai 600018, India; krishnanars@yahoo.com
[3] ICAR—Indian Agricultural Statistics Research Institute, New Delhi 110012, India; sudeep@icar.gov.in
[4] ICAR—Indian Council of Agricultural Research, New Delhi 110012, India; anuradha.agrawal@icar.gov.in (A.A.); nd.nahep@icar.gov.in (R.C.A.)
* Correspondence: sudhir.soam@icar.gov.in

Abstract: The Indian Council of Agricultural Research (ICAR) and the World Bank have collaborated on a project entitled the National Agricultural Higher Education Project (NAHEP) to improve agricultural higher education in India, paving the way for sustainable higher education in agriculture. As part of this project, the present investigation was carried out through national-level workshops involving seven State Agricultural Universities (SAUs) across India, with participants from academia and industry, to strengthen 'academia–industry collaboration' through effective linkages. Based on the responses of 199 respondents from academia and industry, the study demonstrates an absolute need for linkages between universities and industries ($p < 0.001$), which are perceived to help improve higher education sustainably. Academic institutions believe that such linkages benefit students concerning their employability, entrepreneurial skills, and financial support received. At the same time, industries believe that they would benefit from novel technologies and influencing academic curricula. This article also establishes an alliance between some parts of academia and industry in the form of MoUs in the identified areas. However, many other areas need more appropriate linkage models. Both sectors, i.e., academia and industry, concur that such exposure and collaboration between the two entities will help to improve the quality of education. Moreover, such collaborations provide financial support, increase students' employability, and improve their entrepreneurial skills. Among the areas requiring collaboration, the 'capacity building of students' was rated most important by academia and industry. Overall, the present study has significant implications for university administrators and industry leaders involved in enhancing academia–industry cooperation and improving the quality and sustainability of higher education in agriculture. Further, the study greatly contributes to the National Education Policy (NEP) to promote innovation among the student communities through Higher Educational Institutes (HEIs) and to the Sustainable Development Goals (SDGs).

Keywords: academia; industry; collaboration; sustainable agricultural education; linkage; policy

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1. Introduction

The Indian agriculture sector has successfully addressed various production challenges through research, technology, and innovation. The green revolution in India is a testimony to the collaborative efforts of all stakeholders in improving the agriculture sector in India. With globalization, numerous opportunities have arisen, including the involvement of the

corporate sector in the agricultural value chain, the diversification of products to include high-value commodities, and the increasing demand for processed and value-added foods. However, to capitalize on these opportunities, there is a need for highly skilled, motivated, and well-trained agricultural professionals [1]. Currently, agricultural higher education (AHE) in India is provided through the public sector, consisting of 63 State Agriculture Universities (SAUs), 3 Central Agricultural Universities (CAUs), 4 Deemed Universities under the Indian Council of Agricultural Research (ICAR), and four Central Universities with an Agricultural Faculty.

The key challenges facing the Indian agricultural education include being less preferred by talented students, discrimination among faculty, inadequate funding, a lack of operational autonomy, and a fragile public–private partnership [1]. However, these inadequacies could be mitigated by strengthening the link between academia and industry. These factors also impact sustainable education, which is essential to disseminate knowledge in a way that promotes social and economic growth, as well as enabling a comprehensive understanding of human needs across the country [2]. However, due to unprecedented modernization and commodification, sustainable education is currently based on market-driven theory. Agricultural education is no exception to this trend and has undergone a transformation from production to productivity to business-oriented over the last few decades. The United Nations Sustainable Developmental Goals either directly or indirectly influence agricultural education. The SDG 4 aims to ensure access to equitable and high-quality education for all, wherein SDG 4.3 targets equal access to affordable technical, vocational, and higher education. The overarching goal of SDG 4 is to achieve universal access to quality higher education. Besides many other drivers of quality education, collaboration between academia and industry is a critical requirement. India's ambitious National Education Policy (NEP) 2020 emphasizes the importance of research and innovation in Higher Education Institutes (HEIs) and calls for greater collaboration between academia and industry.

Academia–industry linkage refers to the interaction between parts of the higher education system and industry to facilitate knowledge and technology exchange [3–5]. Academia–industry collaborations have been recognized as crucial in promoting innovation with the ecosystem. There are numerous potential benefits of such collaboration [6], and multiple studies have documented them. Collaborations between academia and industry help in converting research-based technology into new products and services [7–9], bridge the gaps in expertise and skill sets, and foster innovation, thereby sustaining economic growth [10,11]. In addition, academia–industry collaboration provides an alternative source of funds to academia and rich academic knowledge to industry, thus benefitting both parties [12–15].

The study of academia–industry collaboration is essential to address real-world challenges and allow practitioners to adopt novel research-based strategies [16]. This collaboration is also facilitated by the personnel transition between academia and industry, aiding knowledge transfer [17]. Simon [18], in his work, suggested that academia must better prepare students for emerging technologies while still teaching foundational concepts and theories, and research reinforces that academia and industry must collaborate. In addition to increasing the chances of success in research and development, collaboration between academia and industry also contributes to innovation processes [19]. While academia focuses on knowledge creation, industry strives to solve practical problems. Industry can tap into a vast pool of expertise and insights by exploring and exploiting the landscape of academia and its knowledge generation activities globally [20].

Academia and industry are interconnected and rely on each other for their goals. This collaboration between academia and industry also benefits both parties in many other ways. Collaboration between academia and industry is essential in advancing research and development, solving practical problems, fostering innovation, and maximizing the potential for knowledge creation and application [21]. Industry–academia collaboration increases industry's problem-solving capacity by granting access to university equipment

and specialized knowledge [22]. In turn, universities benefit from the collaboration by gaining awareness of the current technologies used in industry and accessing new funding opportunities. Initiating an early collaboration between academia and industry is crucial to leverage the strengths of both sectors and maximize the potential for innovation and knowledge creation [23]. Collaboration between academia and industry drives advanced research and innovation [24].

In recent years, there has been a significant increase in academia–industry collaboration in many developed nations, such as the United States [25], Canada [26], Japan [27], Singapore [6], and the European Union [28–30]. The reasons for this increase can be attributed to various factors that place pressure on both industries and universities [31,32], and such collaborations can lead to a reduction in the time lag between discovery and practical application [33]. Unfortunately, several barriers hinder the productivity of the relationship between academia and industry [34]. Barriers to academic collaboration with industry can be attributed to individual and organizational factors. On an individual level, factors such as conflicting interests and expectations, limitations to career progression, and a lack of knowledge about access to grants hinder collaboration [35]. Berman [36] explored the impediments to sustainable research partnerships between academia and industry and found that the 'cultural gap' between them significantly impedes successful collaboration. Goel et al. [37] investigated the various modes of collaboration between academia and the manufacturing industry in Germany. They found that university scientists typically start collaborations with industry, while firm employees take over the management of projects. Studies suggest that academia–industry collaborations offer benefits, such as improved research uptake, but face challenges, like intellectual property management, publication freedom, value conflicts, and limitations in academic and managerial theorizing [38–40].

Only a few studies have explored academia–industry interactions in developing countries. Gul and Ahmad [41] highlighted the importance of academia–industry linkage and its long-term effects on development in Pakistan with crucial reference to the biotechnology and pharmaceutical industries. Liu [42] analyzed the academia–industry linkages of Hong Kong electronics concerning small and medium-sized enterprises and showed that companies tend to hire highly qualified laborers trained by academic institutions to gain access to advanced academic knowledge. Ansari and Sharma [43] studied academia–industry interactions in India and identified the steps to improve such collaboration. A NISTADS [44] report studied the linkages between several science and technology institutions and highlighted the different types of linkages among them. Using data from seven universities, Bhattacharya and Arora [45] investigated the motivating factors and constraints perceived by academic collaborators. A study by Zabidin et al. [46] highlighted the gaps in collaborative approaches between academia and industry. They developed the Industry–Academia Knowledge Equilibrium framework, which could be applied to other fields related to the study. It has also been found that graduates invariably need to acquire more skills. As employers have the most authority in selecting graduates, it is suggested that universities work together with industries to develop the skills and traits that they demand [47]. Since quality education results in professional and skilled students who are industry-ready, educational institutions must focus on providing high-quality education to contribute to the SDGs [48].

The ICAR is currently operating a mega-research project entitled the National Agriculture Higher Education Project (NAHEP), funded by the World Bank and the Government of India on a 50:50 cost basis, operative at 60 SAUs, CAUs, and ICAR institutes. Under Component 2 of NAHEP, the ICAR National Academy of Agricultural Research Management (NAARM), Hyderabad, is associated with a subproject named 'Investment in ICAR Leadership in Agricultural Higher Education', along with the ICAR Indian Agricultural Statistical Research Institute, New Delhi. Based on the recommendations of the project's International Advisory Committee (Supplementary Material: Table S1), a global study was undertaken to analyze the academia–industry collaborations in various global universities, with the specific objectives of (i) studying the perceptions of academia and industry regard-

ing the linkages among them and (ii) identifying areas that require collaboration between academia and industry towards improving agricultural higher education (AHE) in India, in line with the NEP 2020.

This study is based on the triple helix model (THM) approach that can be employed to create an innovation-friendly environment. The three interacting components of this model are industry, government, and universities, which complement each other. The industry desirous of the solution seeks a knowledge source for ideas, duly provided by universities linked to the industry [49]. This study considers two components, academia (agricultural universities) and agri-based industries. The present work was carried out to answer the following research questions: (i) What are the different means of improving higher education through linkages? (ii) What are the areas requiring linkages among academia–industry and academia–academia? (iii) What is the perception of academicians and industrialists regarding the need for linkages between academia and industry? and (iv) What is the perceived effectiveness of these linkages in improving the quality of agricultural higher education, and how can we improve its quality?

2. Materials and Methods

2.1. Conceptual Framework

Over the past two decades, academies have grown significantly. To survive in the age of modernization, industries are compelled to adopt a theory that responds to the market. Adopting a flexible theory in regard to the market will undoubtedly stop academia from adhering to the founding principles of educational philosophy. We propose a conceptual framework for the sustainable growth of academia in collaboration with industry, as shown in Figure 1. This framework also includes the research questions.

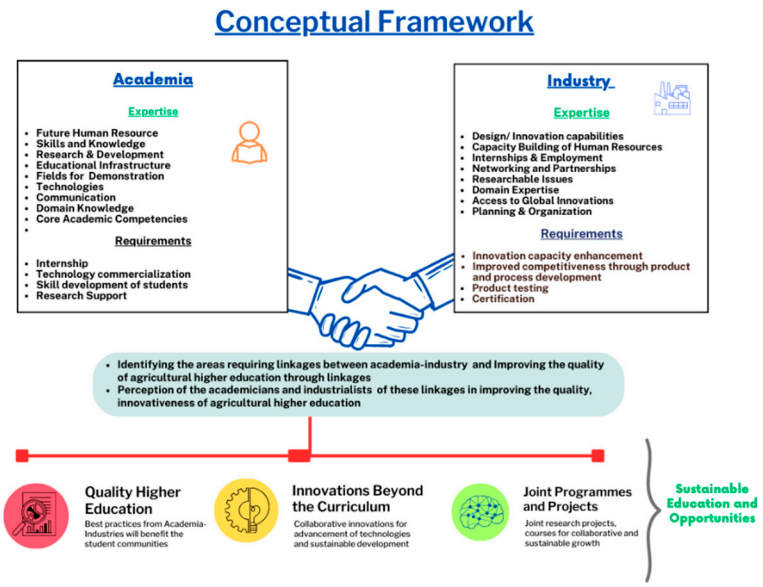

Figure 1. Conceptual framework of academia–industry linkages for sustainable education and opportunities in agricultural higher education.

2.2. Sampling Plan and Data Collection

The stratified random sampling plan was employed to collect the data required to conduct the study. The country was divided into seven strata comprising different states and union territories based on agro-ecological regions. The ICAR-NAARM organized seven consultative workshops on 'Academia–Industry–Government Linkages for Quality Agricultural Education' in each of these strata during the year 2019 (Supplementary Material: Table S2). Stakeholders from all the states and union territories (except Goa) participated in these workshops. Faculty members from Central Agricultural Universities (CAUs) and State Agricultural Universities (SAUs), professionals from agri-based industries involved in

producing and marketing farm inputs, agri-service providers, and consultancy firms were randomly selected from each of these strata and were invited to participate in the workshop. The current status, challenges, and prospects of academia–industry–government linkages were discussed in this workshop. After deliberation, a structured survey questionnaire was distributed among the participants, and the responses were collected. The authors developed the questionnaire using a Likert-type standardized scale [50,51]. The questionnaire aimed to gather information on the role of academia–industry linkages in improving the quality of AHE in India.

The responses from 199 respondents were collected and analyzed, with 84.4% being faculty members (n = 168) and 15.6% being professionals from agri-based industries (n = 31). Data with basic details of the respondents, including gender, designations, and organizations, were collected. The gender-wise and sector-wise distribution of the respondents is given in Table 1. The Likert scale, ranging from 1 (not at all) to 5 (significantly), was used to gather respondents' perceptions on the need for linkages between academia and industry and their effectiveness in improving the quality of higher education in agriculture. The questionnaire also included statements on how linkages could improve AHE quality, and respondents were asked to rate the comparative importance of academia–industry, and academia–academia linkages on a Likert scale.

Table 1. Gender-wise and sector-wise distribution of the respondents.

Category	Male	Female	Total
Academia	140	28	168
Industry	31	00	31
Total	171	28	199

2.3. Statistical Analysis

The data collected through the questionnaires were analyzed using appropriate statistical techniques. The percentages of responses for various points on the Likert scale were calculated. Categorical responses were subjected to descriptive statistical analyses in accordance with Venkatesan and Biwas [52]. To compare the central tendency scores from respondents in academia and industry, Mood's median test [53] was employed, which is a nonparametric test best suited for categorical and ordinal data. Polychoric correlation, a technique used to estimate the correlation between two theorized, normally distributed, continuous latent variables from two observed ordinal variables, was used to measure the correlations among the areas requiring linkages [54].

Exploratory factor analysis (EFA) was performed to study the underlying structure of the areas requiring academia–industry linkage. EFA helps to discover the number of factors influencing the variables and to identify similar variables [55]. The Kaiser–Meyer–Olkin (KMO) test of factorial adequacy and Bartlett's test for sphericity were used to check the suitability of data for the factor analysis. The KMO test returns values between 0 and 1, and a value above 0.8 suggests adequate sampling [56]. Bartlett's test checks the correlation among variables necessary for the factor analysis [57]. The critical areas requiring collaboration were grouped based on their factor loadings. The internal consistency among the areas representing a particular group, obtained from EFA, was measured using Cronbach's reliability coefficient [58]. All analyses were conducted using the R 3.6.2 statistical programming language, and the infographics were created using PowerBI.

3. Results

3.1. Perception of Needs and Outcomes from Academia–Industry Linkages

The study analysis indicated a critical requirement for linkages between industry and academia in the AHE sector (Figure 2). More than 50% of the respondents from academia and more than 46% of the respondents from industries emphasized the strong need for collaboration. However, the respondents from academia felt that the need for

collaboration among academia was significantly higher ($p < 0.001$) than that of academia and industry. Similarly, respondents from industry opined that the need for collaboration among industries was significantly higher ($p < 0.01$) than that between industry and academia. These p values indicate a significant difference in the perceptions of academicians and industrialists about academia–industry linkages. In the study, more than 90% of the respondents from academia and more than 85% of the respondents from industry felt that linkages would significantly enhance AHE quality (Figure 3).

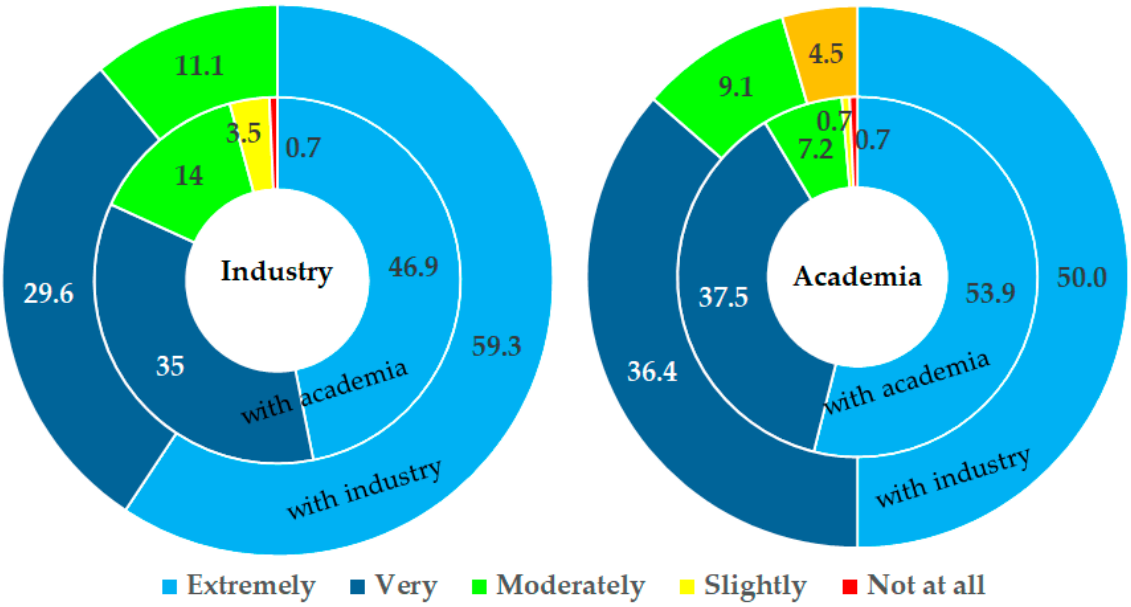

Figure 2. Respondents' perceptions on 'need for collaboration' (values in %).

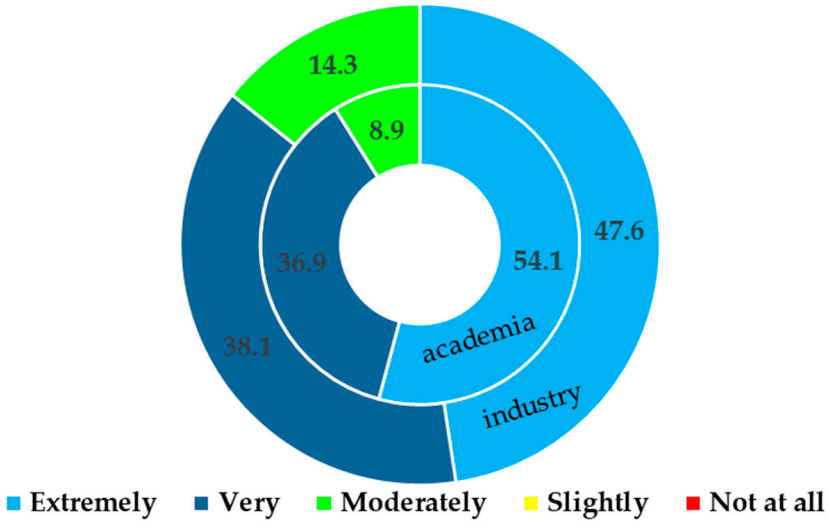

Figure 3. Respondents' perceptions about 'improvement in the quality of higher education by collaboration' (values in %).

3.2. Means of Improving Higher Education through Linkages for Sustainable Agricultural Higher Education

Table 2 summarizes respondents' views on enhancing higher education through linkages, suggesting vast opportunities for academia and industry to collaborate towards shared objectives. Both groups agreed that collaboration would provide academic students with practical exposure and hands-on training in industry settings. Academia members strongly felt that linkages could help in increasing students' employability

(average score = 4.44), securing internships and scholarships (average score = 4.25), and improving their entrepreneurial skills (average score = 4.20). Industry representatives strongly felt that linkages helped in developing entrepreneurial skills among students (average score = 4.37) and that universities adopting newer technologies (average score = 4.28) and designing curricula based on industry needs (average score = 4.22) can benefit the industry. However, respondents expressed less support for the notion that linkages would lead to greater academic, administrative, and financial autonomy (average score = 3.83). Mood's median test indicated that the distribution of responses from both academia and industry was similar, except for the statement that 'students will get practical exposure/hands-on training in industry' (Table 2).

Table 2. Means of improving higher education through linkages.

Statements	Average Score			Median Test [#] (p)
	A.U. (n = 151)	Ind. (n = 17)	Overall (n = 168)	
• Students will get practical exposure/hands-on training in industry	4.44	4.60	4.46	<0.01
• Students' employability will be increased	4.24	4.05	4.22	0.95
• Industry can adopt new technologies with the help of the university	4.06	4.28	4.09	0.50
• Will help in design/modification of the curricula in academia according to the needs of the industry	4.09	4.22	4.10	0.98
• Will facilitate sponsoring of students' research and internship/fellowships	4.25	3.79	4.20	0.07
• Will develop entrepreneurship among students	4.20	4.37	4.22	0.82
• Will encourage greater academic, administrative, and financial autonomy	3.83	3.84	3.83	0.97

Scale: 1—Not at all; 2—Slightly; 3—Moderately; 4—Very; 5—Extremely. [#] A p-value less than 0.05 rejects the null hypothesis that both distributions are the same.

3.3. Areas Requiring Linkages between Academia and Industry

The respondents were asked to rate 14 different pre-identified areas in a five-point continuum on a Likert scale. The results indicated that, among these areas, sharing hi-tech lab facilities (average score = 4.63), networking (average score = 4.47), and soft skills and career development for students (average score = 4.46) were rated as the most critical areas requiring collaboration. This was followed by entrepreneurship development (average score = 4.43), training and internships (average score = 4.4), and human resource development (average score = 4.41) (Table 3). The remaining variables were given comparatively less priority.

The responses were analyzed using exploratory factor analysis (EFA) after the adequacy of the sample was established based on the high Kaiser–Meyer–Olkin (KMO) value (0.88). Two factors emerged with eigenvalues greater than one, capturing 60% of the variation in the data, with the first factor accounting for 39% and the second for 21%. Based on the factor loadings, each variable found representation mostly in any of the two factors (Table 3). The factor loadings of variables with direct or indirect financial obligations, such as training and internships, industrial parks, entrepreneurship development, technology commercialization, networking, consultancy services, facility sharing, and skills and development centers, were collectively represented by the financial factor. Variables such

as inclusion in the board of directors, knowledge management, databases, and curriculum design fell under the technical factor, while human resource development had equal loadings in both factors. Subsequently, the two factors could be defined as financial and technical factors. The high values for Cronbach's alpha (0.86 and 083 for factor 1 and factor 2, respectively) confirmed the internal consistency of these two factors. The matrix of polychoric correlations between these variables is presented in Figure 4.

Table 3. Results of the factor analysis on areas requiring linkages between academia and industry.

	Variables	Mean Score	Loadings	
			Factor 1	Factor 2
V1	Training and Internships	4.40	0.59	0.02
V2	Industrial Parks	3.89	0.54	0.05
V3	Entrepreneurship Development	4.43	0.57	0.09
V4	Technology Commercialization	4.38	0.69	−0.04
V5	Networking	4.47	0.46	0.30
V6	Consultancy in Services (Product Testing, Certification, etc.)	4.30	0.69	−0.01
V7	Sharing Hi-Tech Lab Facilities	4.63	0.77	−0.06
V8	Soft Skills and Career Development for Students	4.46	0.65	0.06
V9	Inclusion in Board of Directors	3.72	−0.11	0.81
V10	Knowledge Management	4.30	0.02	0.74
V11	Databases for Information	3.99	0.25	0.49
V12	Mutual Trust	4.15	0.19	0.53
V13	Curriculum Design	4.07	0.09	0.53
V14	Human Resource Development	4.41	0.35	0.39
	Variance proportion explained		39%	21%
	Internal consistency (Cronbach's α value) (n = 199)		0.86	0.83

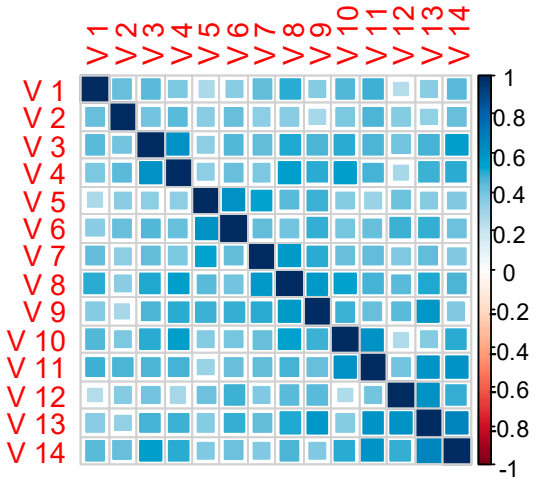

Figure 4. Polychoric correlation matrix depicting the extent of correlation among areas requiring collaboration between academia and industry (Note: dark blue—strong positive correlation; dark red—strong negative correlation).

3.4. Areas Requiring Linkages among Academic Institutions

A Likert scale was used to grade 15 pre-defined areas requiring linkages within academia (Table 4). Among the 15 areas, research resource support (average score = 4.61), technology incubation centers (average score = 4.45), and student exchange programs (average score = 4.40) were rated as the most critical areas requiring collaboration. The suitability of the data for EFA was confirmed by the KMO test (KMO = 0.95) and Bartlett's

test (chi-square = 2279.753, $p < 0.01$). Subsequently, the data were analyzed using EFA (Table 4).

Table 4. Results of the factor analysis on areas requiring linkages among academia.

	Variables	Mean Score	Loadings	
			Factor 1	Factor 2
V1	Consultancy and Contract Research	4.17	0.64	0.14
V2	Training and Development of Staff	4.39	0.62	0.10
V3	Student Internships	4.34	0.45	0.26
V4	Technology Incubation Centers	4.45	0.88	−0.07
V5	Networking	4.25	0.66	0.16
V6	Joint Courses	3.96	0.61	0.19
V7	Consultancy for Higher Education	4.17	0.74	0.04
V8	Student Exchange Program	4.44	0.80	0.05
V9	Sharing of Infrastructural Services	4.34	0.59	0.19
V10	Quality Improvement Programs	4.36	0.95	−0.15
V11	Joint Patents	4.13	0.10	0.78
V12	Joint Publications	4.22	−0.05	0.99
V13	Joint Projects	4.33	0.09	0.73
V14	Research Resource Support	4.61	0.33	0.52
V15	Research Guidance	4.30	0.42	0.39
	Variance proportion explained		34%	23%
	Internal consistency (Cronbach's α value) (n = 199)		0.94	0.91

Based on the eigenvalues, two factors were sufficient to capture 57% of the variation in the data, out of which the first factor explained 34% of the variation. The variables were assigned to these two factors based on the factor loadings. The first factor consisted of consultancy and contract research, the training and development of staff, student internships, technology incubation centers, networking, joint courses, consultancy for higher education, student exchange programs, the sharing of infrastructural services, and quality improvement programs. The second factor included joint patents, publications, joint projects, and research resource support. Looking at the areas included, factor 1 could be financial, and factor 2 could be technical. However, the area of research guidance had approximately equal loadings on both factors. The polychoric correlations between these variables are shown in Figure 5.

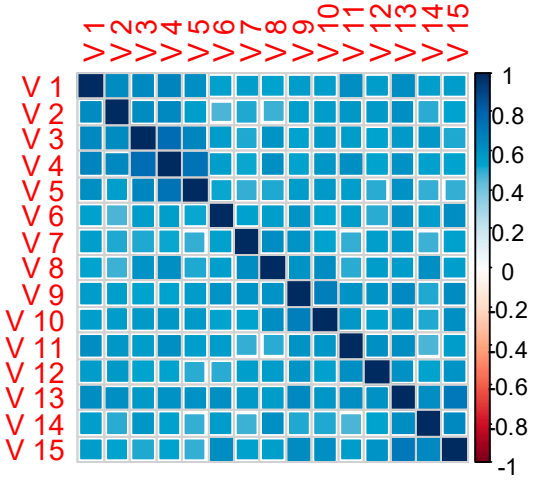

Figure 5. Polychoric correlation matrix depicting the extent of correlation among areas requiring collaboration within academia. (Note: dark blue—strong positive correlation; dark red—strong negative correlation).

3.5. Present Status of Linkages

Some universities and industries already have some linkages with each other, but there is still much scope for improvement. The majority of the respondents from both universities (70.0%) and industries (65.0%) indicated that some linkages currently exist. However, only 50.7% of universities and 58.8% of industries have established models for linkages in the form of a Memorandum of Understanding (MoU), highlighting the need to develop other models to establish more linkages. In addition, only 49.3% of universities and 28.6% of industries reported having institutional mechanisms such as representation and participation on boards, committees, and councils related to academia–industry linkages.

In a similar survey conducted by ICAR-NAARM in 2022, results showed that approximately 44% of universities had linkages with more than 15 industries (from the unpublished data of NAHEP Component 2) concerning the career development and placement of students (Figure 6a). Out of the total number of MoUs (168) signed by universities with industries, 164 were national, and only four were international (Figure 6b). On average, approximately nine MoUs were signed by each university with industries.

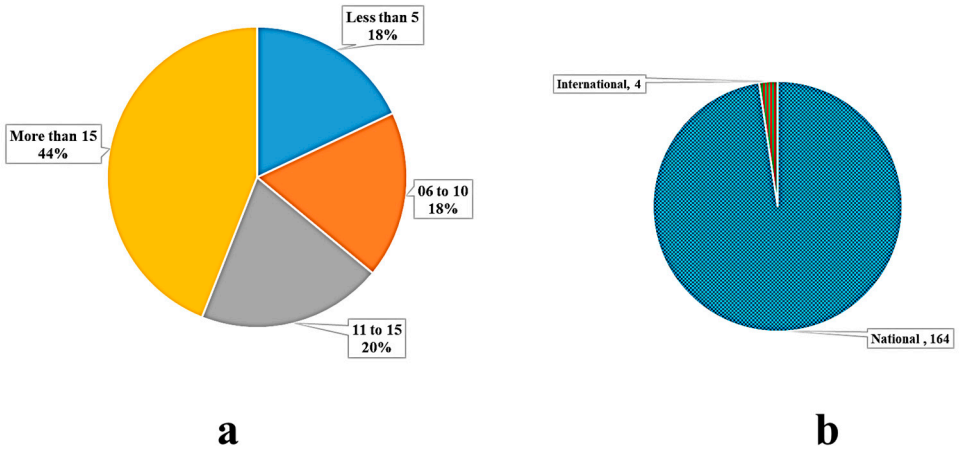

Figure 6. (**a**) Number of industries linked with universities regarding career development and placements of students; (**b**) number of MoUs signed by universities with national and international industries.

4. Discussion

4.1. Academia–Industry Linkages for Mutual Benefit

The current study's findings indicate a significant need for linkages between academia and industry in terms of gaining practical exposure and hands-on training, as indicated by most respondents. Collaborations between academia and industry have been ongoing for several decades to transfer knowledge and combine strengths for mutual and societal benefits [59]. These linkages provide benefits to both academia and industry in numerous ways. For industry, relations with universities help to enhance their innovation capacity and improve competitiveness through product and process development. Similarly, universities benefit from increased financial and other resources, access to updated good practices, technical knowledge, knowledge creation and utilization networks, industrial information, applied knowledge, and visibility through the transfer of proper scientific knowledge, increased workforce participation, and the development of students [13,14,60–63].

The benefits that industries can gain from collaborations with universities and public research organizations are access to basic and applied research results, economically relevant scientific and technological knowledge, and the ability to develop and test prototypes. Industries also receive support in solving specific problems, obtaining new product specifications, and recruiting highly qualified and skilled personnel. Industries have often shown interest in collaborating with universities and public research organizations to improve their innovation performance and benefit from the new scientific knowledge produced [64].

Universities in many countries face significant pressure to secure private sector funding [65]. Academia–industry collaborations have resulted in many innovative products [66]. The emergence of science and technology-based industries has motivated academia to play a more direct role in innovation [31,67,68].

4.2. Areas Requiring Academia–Industry Linkages

This study reveals that areas such as sharing hi-tech lab facilities, networking, and soft skills and career development for students are the most crucial for academia–industry linkages, followed by training and internships and entrepreneurship development. Linkages between academia and industry are essential in maintaining quality standards in research and development, generating new scientific and technological capabilities, and producing research and development resources [45]. Industry can benefit from academic institutions by acquiring and utilizing research results; hiring students, graduates, and researchers to enhance their innovation capabilities; and providing financial support for academic research to support their product development [42]. The objectives of academia and industry may differ, requiring significant effort from both parties to collaborate effectively [69]. This study reveals that the areas requiring collaboration also vary among them. Despite this, many areas encourage collaboration, which can be grouped into two broad categories: the first is technical collaboration, where there is an exchange of ideas and innovations; the second is financial collaboration, where the facilities are shared between the collaborators, and there is financial support from one to the other. Prior studies suggest that the academia–industry linkage relationship may differ across industries as the organizational characteristics of companies and the business and legal environments in which companies operate vary [4]. Likewise, academic institutions also differ concerning their innovation goals and how they innovate [70].

Academia focuses more on basic sciences, whereas companies focus more on applied research with the goal of profit maximization [71]. Towards this, industries use their own knowledge and technologies, which they either have developed independently or acquired from other sources, such as academic and research institutions. Industries may obtain knowledge and technologies from academia by acquiring patents and licenses developed by academia, partnering with academic institutions to develop technologies, or hiring students and graduates and attracting researchers to join them in their endeavors [42,72–74]. Transnational academic mobility is necessary for knowledge development and academic quality [75]. In the NITI Aayog document [76], Strategy for New India @75 (under Section 26. Skill development), it has been highlighted that industry–institute linkage is crucial in providing cross-learning by teachers and industry experts. It helps to upgrade teachers' capacity to provide a quality education with skills development. Similarly, transnational academia–industry collaboration will help to achieve academic excellence. In the Working Group Report [77] on 'Strengthening academia–industry interface for the 11th 5-year plan', it was also emphasized that industry–institute linkage is crucial in providing cross-learning by teachers and industry experts by upgrading the capacity of teachers to provide quality education and helping students to find placements through established relationships with industry.

4.3. Academia–Industry Linkages for Higher Education

Though academia and industry differ in perceiving how collaboration can improve AHE, there is a unanimous belief that collaboration is necessary. Academia believes that the students most benefit from such linkages either through industrial exposure or grants and fellowships. Since higher education produces graduates for industry, an industry-driven approach is desperately needed to increase the effectiveness of higher education through a scientifically well-regulated levy system. In addition to having the option of pre-paid tuition, students may also take advantage of a post-paid fees method, where the university should collect its fees directly from the hiring industry on behalf of its employed graduates [2]. Collaboration with universities allows industry to access new knowledge

and save costs incurred for their R&D [78,79]. At the individual level, collaboration has been proven beneficial to education [80]. Collaboration between universities and industry will likely improve the communication between higher education, universities, and industry [81]. A framework developed by Al-Sultan and Al-Zaharnah [82] to promote research and development in Saudi institutions of higher education suggested continuing to engage with enterprises and formal consultation with industries to structure M.Sc. and Ph.D. programs that address industry requirements, as the availability of only a small number of graduates remains an obstacle to knowledge generation.

4.4. Vision of NEP 2020 to Strengthen Higher Education

As per the Indian National Education Policy (NEP) 2020 published by the Ministry of Human Resource Development, India, under Section 9: Quality Universities and Colleges: A New and Forward-Looking Vision for India's Higher Education System, and Subsection 11.12: Higher Education Institutes, it is necessary to focus on research and innovation by setting up more significant industry–academia linkages. The NEP also stresses that while providing rigorous research-based specialization in graduate, master's, and doctoral education, they should also provide opportunities for multidisciplinary work, in academia, the government, and industry. In addition, opportunities for internships with local industries, businesses, artists, etc., for students at higher educational institutes, and research internships with faculty and researchers at their respective or other institutions, would help to engage students actively in practical learning that improves their employability.

4.5. The Way Forward for Academia–Industry Linkages in India for Sustainable Agriculture Higher Education and Innovation

In India, nurturing and expanding the existing linkages between academia and industries is essential for educational progress and in promoting sustainability in agriculture and higher education. A multifaceted approach is necessary to achieve this, involving legislative measures and institutionalized frameworks fostering industry–academia connections, with active government support. Moreover, barriers such as a lack of mutual trust and appreciation, a lack of infrastructure, different standards of evaluation, different ethos, a lack of financial gains, problems with the mutual ownership of Intellectual Property Rights (IPRs), a lack of communication, poor research management, obsolete research topics, a fear of sharing sensitive information, etc., act as constraints in establishing fruitful linkages [45,83]. Soam et al. [84] identified possible linkages to the General Agreement on Trade in Services (GATS) challenges and global standards in 'Agricultural Higher Education' in India. It is evident from the present study that although some collaboration exists between academia and industry, only a few have established models for such linkages, indicating the need for institutionalization. The relationships between academia and industry are often founded on unequal expectations and are usually characterized by short-term arrangements. Without regulations governing public goods and the public interest, sustainable education will remain unattainable for developing countries and only theoretical. Educational resources are often heavily misused or squandered in the absence of sustainable education, likely leading to educational inflation [2]. Furthermore, cultural divergences are high and often lead to disappointing outcomes [85]. Approaches that involve attitudinal changes and the cross-sharing of values are required to overcome these issues [13]. Many studies have also explored the role of public and private provisions in delivering sustainable higher education by comparing the strengths and weaknesses of each counterpart. Without sacrificing the tenets of higher education, academia and industry must acknowledge the overwhelming realities of 21st-century higher education. By addressing these issues and fostering a culture of sustainability, academia and industry in India can truly enhance the quality of agricultural higher education sustainably.

4.6. Institutionalization in Sustainable Education: Challenges and Opportunities

The study highlights the critical need for institutionalization to facilitate successful academia–industry linkages and to establish sustainable agricultural higher education in India. While globalization and internationalization have brought opportunities for higher education in developing countries, they must be mindful of creating a sustainable education system, rather than relying solely on the export of students and the loss of foreign exchange. This sustainable approach involves using research and innovation to transform elementary and secondary education into long-term, locally relevant solution providers. Further, the government should enact enabling policies and regulations to promote the sustainability of agriculture and higher education, by encouraging the inclusion of sustainability criteria in funding allocations and educational accreditation processes. Moreover, students should be involved in sustainability initiatives, fostering a sense of responsibility and passion for environmental and social causes. This would equip them with practical skills and ensure a new generation of sustainability advocates.

Suppose that we see higher education in developing countries. In this case, it is now forced to act as an agent that advances the interests of its main counterparts due to the complete one-way traffic and trade resulting from this borrowing paradigm. This is referred to as internationalization in higher education, which might not produce a sustainable education system. Additionally, the General Agreement of Trade and Services (GATS) ruling, which permits higher education as an international commodity, has not been well utilized by higher education in the eastern part of the world [2]. Many students from developing countries travel to the west for higher education, which can result in a direct loss of foreign exchange. It is ideal for higher education to use research and innovation to mold elementary and secondary education into sustainable providers. A popular belief is that merit-driven higher education, and not elite-driven higher education, supports sustainable development in education.

The most important aspect that must be implemented nationwide is the standardization of national education programs. The alignment of a nation's economic and social development goals with a human needs perspective should be considered when deciding on this standardization. Not socioeconomic status but the students' merits alone should be the deciding factor in the education that they receive. Adherence to the concept of standardized education is mandatory for all educational institutions. Moreover, a sustainable education system should mechanize the returns on education for both the public and private sectors, ensuring that graduates contribute to the nation's development. To make higher education more effective and industry-oriented, it is crucial to establish a system driven by industry participation. This includes the meaningful engagement of stakeholders such as academicians and industrialists to collectively work towards sustainable innovation [2,86]. Such an approach will enhance the quality of education and contribute to India achieving the Sustainable Development Goals in agriculture and higher education.

5. Conclusions

The present study holds several implications for the administrators of universities and firms in terms of strengthening academia–industry collaboration towards improving the quality of higher education in agriculture. First, this study highlights the absolute need for academia–industry collaboration and linkages within each group. Second, respondents from both sectors believed that such collaborations helped in improving the quality of higher education in agriculture. However, academia and industry differ in their perceptions of the extent to which such collaborations help students to obtain practical industry exposure. A higher collaboration requirement is suggested to exist within academia, rather than between academia and industry. Similarly, among industry, it is believed that there is a higher collaboration requirement among industries than between industry and academia. Nevertheless, both sectors concur that such exposure will help to improve the quality of education. Moreover, such collaborations provide financial support, increase students' employability, and improve their entrepreneurial skills. Among the

areas requiring collaboration, the capacity building of students was rated most important by academia and industry. Therefore, under this project, 'Career Development Centers' have been started in five Agricultural Universities. The exchange of students was ranked highly among academia. The areas can be grouped into two broad categories, technical and financial, according to their implications. This study showed that most industries and academia already had some collaboration between and among them. However, the study found that only a few had a structured model that could be scaled up and institutionalized to strengthen linkages. There are various ways to improve the quality and relevance of agricultural higher education. These include flexible curriculum design, development, and implementation. The National Education Policy (NEP) 2020 emphasizes the creation of large, multidisciplinary higher education institutions that facilitate research and innovation, which requires effective linkages among stakeholders—more specifically, among academia and industry. The AHE will focus on research and innovation by setting up incubation centers, technology development processes, centers in frontier research areas, more significant industry–academic linkages, and interdisciplinary research, including humanities and social science research. The development of national, state, and university-level policies for academia–industry linkages would improve the quality of agricultural higher education and promote sustainable innovation and the growth of the nation. Without sustainable education, there would be the significant waste or misuse of educational resources, which would, in turn, lead to educational inflation. Thus, the foundation for sustainability in education is critical for sustainable education.

The key limitations of the present investigation are as follows: (i) we considered a small number of multinational industries and few State Agricultural Universities; (ii) the parameters used in the questionnaire were developed through brainstorming sessions and by referring to the existing literature; and (iii) we diversified the sample size from stratum to stratum, which altogether led to unequal representation. Surveying more universities and diverse industries with critical analyses would further enhance our understanding and allow us to make better decisions. Overall, the present research supports the NEP in introducing hand-holding mechanisms and competitions to promote innovation among student communities within HEIs and also in meeting the requirements for the 21st century and promoting vocational education.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su152316450/s1, Table S1: Experts of the International Advisory Committee of NAHEP (Component 2); Table S2: Details of the consultative workshops conducted.

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References

1. Tamboli, P.M.; Nene, Y.L. Modernizing Higher Agricultural Education System in India to Meet the Challenges of 21st Century. *Asian Agri-Hist.* **2013**, *17*, 251–264.
2. Alam, G.M. Sustainable Education and Sustainability in Education: The Reality in the Era of Internationalisation and Commodification in Education—Is Higher Education Different? *Sustainability* **2023**, *15*, 1315. [CrossRef]
3. Siegel, D.S.; Waldman, D.; Link, A. Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Res. Policy* **2003**, *32*, 27–48. [CrossRef]
4. Bekkers, R.; Freitas, B.I. Analyzing knowledge transfer channels between universities and industry: To what degree do sectors also matter? *Res. Policy* **2008**, *37*, 1837–1853. [CrossRef]
5. Broström, A.; Feldmann, A.; Kaulio, M. Structured relations between higher education institutions and external organizations: Opportunity or bureaucratization? *High. Educ.* **2021**, *78*, 575–591. [CrossRef]
6. Lee, J.; Win, H.N. Technology transfer between university research centers and industry in Singapore. *Technovation* **2004**, *24*, 433–442. [CrossRef]
7. Etzkowitz, H. Bringing the gap: The evolution of industry–university links in the United States. In *Industrializing Knowledge: University–Industry Linkages in Japan and the United States*; Branscomb, L., Kodama, F., Florida, R., Eds.; The MIT Press: Cambridge, MA, USA, 1999.
8. Nieminen, M.; Kaukonen, E. *Universities and R&D Networking in a Knowledge-Based Economy*; oSITRA-Reports Series 11; SITRA: Helsinki, Finland, 2001.
9. European Commission. *Good Practice in Industry-Science Relations, Benchmarking Papers, No. 5*; European Commission: Bâtiment Konrad Adenauer, Luxembourg, 2002.
10. Anselin, L.; Varga, A.; Acs, Z. Local Geographic Spillovers between University Research and High Technology Innovations. *J. Urban Econ.* **1997**, *42*, 422–448. [CrossRef]
11. Jaffe, A. Real Effects of Academic Research. *Am. Econ. Rev.* **1989**, *79*, 957–970.
12. Hakansson, H.; Snehota, I. *Developing Relationships in Business Networks*; Routledge: London, UK, 1995.
13. Martin, M. *Managing University–Industry Relations: A Study of Institutional Practices from 12 Different Countries*; UNESCO, International Institute of Educational Planning: Paris, France, 2000.
14. Organization for Economic Cooperation and Development (OECD). *Science, Technology and Industry Outlook: Drivers of Growth: Information, Technology, Innovation and Entrepreneurship*; OECD: Paris, France, 2001.
15. Mendoza, P. The role of context in academic capitalism: The industry-friendly department case. *J. High. Educ.* **2012**, *83*, 26–48. [CrossRef]
16. Alshahwan, N.; Felderer, M.; Ramler, R. Industry-academia collaboration in software testing: An overview of TAIC PART 2015. In Proceedings of the 2015 IEEE Eighth International Conference on Software Testing, Verification and Validation Workshops (ICSTW), Graz, Austria, 13–17 April 2015; pp. 1–2.
17. Sridharan, S.A.; Ramrao, N.; Murugan, K.; Prasad, V.; Krishna, R.; Nair, R. The Significant Contextual Predictors of Industrial Academic Collaboration in Engineering. *J. Eng. Educ. Transform.* **2020**, *34*, 154. [CrossRef]
18. Simon, L. Training the Future Engineering Workforce. *Mech. Eng.* **2023**, *145*, 30–35. [CrossRef]
19. Olszewski, M. Scientists' attitudes towards academic entrepreneurship: The results of an empirical study. *Entrep. Educ.* **2021**, *17*, 7–18. [CrossRef]
20. Anon Higon, D.; Díez-Minguela, A. Do universities matter for the location of foreign R&D? *BRQ Bus. Res. Q.* **2021**, 23409444211042382.
21. Ayele, W.Y.; Juell-Skielse, G. A Process Model for Generating and Evaluating Ideas: The Use of Machine Learning and Visual Analytics to Support Idea Mining. In Proceedings of the Electronic Government and the Information Systems Perspective: 9th International Conference, EGOVIS 2020, Bratislava, Slovakia, 14–17 September 2020; Proceedings 9. Springer Nature Switzerland AG: Cham, Switzerland, 2020; pp. 189–203.
22. de Jager, K.; Chimhundu, C.; Douglas, T.S. The medical device development landscape in South Africa: Institutions, sectors and collaboration. *S. Afr. J. Sci.* **2017**, *113*, 1–8. [CrossRef] [PubMed]
23. Cowling, B.S.; Thielemans, L. Translational medicine in neuromuscular disorders: From academia to industry. *Dis. Models Mech.* **2020**, *13*, dmm041434. [CrossRef]
24. Anggraeni, S.K.; Maarif, M.S.; Raharja, S. Prospective Strategy for Strengthening the Fish Processing Innovation System in Banten Province. In Proceedings of the 2nd and 3rd International Conference on Food Security Innovation (ICFSI 2018–2019), Serang, Indonesia, 23 October 2018–9 September 2019; Atlantis Press: Amsterdam, The Netherlands, 2021; pp. 150–155.
25. Lehrer, M.; Nell, P.; Garber, L. A national systems view of university entrepreneurialism: Inferences from comparison of the German and U.S. experience. *Res. Policy* **2009**, *38*, 268–280. [CrossRef]
26. Fisher, D.; Atkinson-Grosjean, J. Brokers on the boundary: Academy-industry liaison in Canadian universities. *High. Educ.* **2002**, *44*, 449–467. [CrossRef]
27. Woolgar, L. New institutional policies for University—Industry links in Japan. *Res. Policy* **2007**, *36*, 1261–1274. [CrossRef]

28. Barrett, D.; Austin, J.E.; McCarthy, S. Cross-sector collaboration: Lessons from the international trachoma initiative. In *Public—Private Partnerships for Public Health*; Reich, M., Ed.; Harvard University Press: Cambridge, MA, USA, 2000.
29. Powers, J.B. Commercializing academic research: Resource effects on performance of university technology transfer. *J. High. Educ.* **2003**, *74*, 26–47. [CrossRef]
30. Gertner, D.; Roberts, J.; Charles, D. University—Industry collaboration: A CoPs approach to KTPs. *J. Knowl. Manag.* **2011**, *5*, 625–647. [CrossRef]
31. Meyer-Krahmer, F.; Schmoch, S. Science-based technologies: University—Industry interactions in four fields. *Res. Policy* **1998**, *27*, 835–851. [CrossRef]
32. Giuliani, E.; Arza, V. What drives the formation of 'valuable' University—Industry linkages? Insights from the wine industry. *Res. Policy* **2009**, *38*, 906–921. [CrossRef]
33. Lai, W.H. Willingness-to-engage in technology transfer in industry–university collaborations. *J. Bus. Res.* **2011**, *64*, 1218–1223. [CrossRef]
34. Bruneel, J.; D'esteb, P.; Salter, A. Investigating the factors that diminish the barriers to University—Industry collaboration. *Res. Policy* **2010**, *39*, 858–868. [CrossRef]
35. Karlsdottir, V.; Torfason, M.T.; Edvardsson, I.R.; Heijstra, T.M. Barriers to academic collaboration with industry and community: Individual and organisational factors. *Ind. High. Educ.* **2023**. [CrossRef]
36. Berman, J. Connecting with industry: Bridging the divide. *J. High. Educ. Policy Manag.* **2008**, *30*, 165–174. [CrossRef]
37. Goel, R.K.; Goktepe-Hulten, D.; Grimpe, C. Who instigates University–industry collaborations? University scientists versus firm employees. *Small Bus. Econ.* **2017**, *48*, 503–524. [CrossRef]
38. Kneller, R.; Mongeon, M.; Cope, J.; Garner, C.; Ternouth, P. Industry-University Collaborations in Canada, Japan, the UK and USA—With Emphasis on Publication Freedom and Managing the Intellectual Property Lock-Up Problem. *PLoS ONE* **2014**, *9*, 302. [CrossRef]
39. Cherney, A. Academic–industry collaborations and knowledge co-production in the social sciences. *J. Sociol.* **2015**, *51*, 1003–1016. [CrossRef]
40. Crespin-Mazet, F.; Ingemansson-Havenvid, M. Rethinking the theory-practice divide: How academia-industry collaboration contributes to theorising. *Ind. Mark. Manag.* **2020**, *92*, 277–288. [CrossRef]
41. Gul, A.; Ahmad, A. Perspectives of Academia-Industrial Linkage in Pakistan: An Insight Story. *Sci. Technol. Dev.* **2012**, *31*, 175–182.
42. Liu, W. *Academia-Industry Linkages and the Role of Active Innovation Policies—Firm-Level Evidence in Hong Kong*; Kiel Working Paper No. 1577; Kiel Institute for the World Economy: Kiel, Germany, 2009.
43. Ansari, M.M.; Sharma, T.C. Industry and Universities in India: Is the collaborative effort succeeding? *Ind. High. Educ.* **1991**, *5*, 143–154. [CrossRef]
44. NISTADS. *A Study on Linkages of Research Institutions with Academic Institutions and Industrial Organisations*; NISTADS_REP-72-89; NISTADS: New Delhi, India, 1989.
45. Bhattacharya, S.; Arora, P. Industrial linkages in Indian universities: What they reveal and what they imply? *Scientometrics* **2007**, *70*, 277–300. [CrossRef]
46. Zabidin, N.; Belayutham, S.; Ibrahim, C. The knowledge, attitude and practices (KAP) of Industry 4.0 between construction practitioners and academicians in Malaysia: A comparative study. *Constr. Innov.* **2023**. [CrossRef]
47. Hoque, N.; Uddin, M.; Ahmad, A.; Mamun, A.; Uddin, M.; Chowdhury, R.; Alam, A. The desired employability skills and work readiness of graduates: Evidence from the perspective of established and well-known employers of an emerging economy. *Ind. High. Educ.* **2023**, *37*, 716–730. [CrossRef]
48. Soam, S.K.; Kalpana Sastry, R.; Rashmi, H.B. Trade in Educational Services: An overview of GATS and policy implications for higher agricultural education in India. *J. Agric. Educ. Ext.* **2007**, *13*, 49–68. [CrossRef]
49. Dooley, L.; Kirk, D. University-industry collaboration: Grafting the entrepreneurial paradigm onto academic structures. *Eur. J. Innov. Manag.* **2007**, *10*, 316–332. [CrossRef]
50. Likert, R. A technique for the measurement of attitudes. *Arch. Psychol.* **1932**, *22 140*, 55.
51. Vagias, W.M. *Likert-Type Scale Response Anchors*; Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management; Clemson University: Clemson, SC, USA, 2006.
52. Venkatesan, S.; Biswas, A.K. A Note on Variability for Categorical Variable. In *Technical Report No. SQCOR-2018-04*; SQC & OR Division, Indian Statistical Institute: Kolkata, India, 2018.
53. Mood, A.M. On the Asymptotic Efficiency of Certain Nonparametric Two-Sample Tests. *Ann. Math. Stat.* **1954**, *25*, 514–522. [CrossRef]
54. Gibbons, J.D.; Chakraborti, S. *Nonparametric Statistical Inference*; Marcel Dekker, Inc.: New York, NY, USA, 2003.
55. DeCoster, J. Overview of Factor Analysis. Available online: http://www.stat-help.com/notes.html (accessed on 20 March 2020).
56. Kaiser, H. An index of factor simplicity. *Psychometrika* **1974**, *39*, 31–36. [CrossRef]
57. Bartlett, M.S. The effect of standardization on a Chi-square approximation in factor analysis. *Biometrika* **1951**, *38*, 337–344.
58. Cronbach, L.J. Coefficient Alpha and the Internal Structure of Tests. *Psychometrika* **1951**, *16*, 297–334. [CrossRef]
59. Galan-Muros, V.; Plewa, C. What drives and inhibits university–business cooperation in Europe? A comprehensive assessment. *RD Manag.* **2016**, *46*, 369–382.

60. Jones-Evans, D.; Klofsten, M.; Andersson, E.; Pandya, D. Creating a Bridge Between University and Industry in Small European Countries: The role of the Industrial Liaison Office. *RD Manag.* **1999**, *29*, 47–56. [CrossRef]
61. Hu, M.; Hung, S.; Lo, H.; Tseng, Y. Determinants of University–industry research collaborations in Taiwan: The case of the National Tsing Hua University. *Res. Eval.* **2016**, *25*, 121–135. [CrossRef]
62. Schibany, A.; Schartinger, D. Interactions between universities and enterprises in Austria: An empirical analysis at the micro and sector levels. In *Innovative Networks: Co-Operation in National Innovation Systems*; OECD: Paris, France, 2001.
63. Senker, J. Changing organization of public sector research in Europe-implications for benchmarking human resources in RTD. *Sci. Public Policy* **2001**, *28*, 277–284. [CrossRef]
64. Cassiman, B.; Veugelers, R.; Zuniga, M.P. In Search of performance effects of (in)direct industry science links. *Ind. Corp. Chang.* **2008**, *17*, 611–646. [CrossRef]
65. Perkmann, M.; Tartari, V.; McKelvey, M.; Autio, E.; Brostroem, A.; D'Este, P.; Fini, R.; Geuna, A.; Grimaldi, R.; Hughes, A.; et al. Academic engagement and commercialization: A review of the literature in university-industry relations. *Res. Policy* **2013**, *42*, 423–442. [CrossRef]
66. Inzelt, A. The evolution of university-industry-government relationships during transition. *Res. Policy* **2004**, *33*, 975–995. [CrossRef]
67. Bania, N.; Eberts, R.; Fogarty, M. Universities and the startup of new companies: Can we generalize from Route 128 and Silicon Valley? *Rev. Econ. Stat.* **1993**, *75*, 761–766. [CrossRef]
68. Rees, G. *New Information Technologies and Vocational Education and Training in the New Information Technologies in the European Community*; Background Report; Commission of the European Communities: Cardiff, Wales, 1991.
69. Jongbloed, B.; Enders, J.; Salerno, C. Higher education and its communities: Interconnections, interdependencies and a research agenda. *High. Educ.* **2008**, *56*, 303–324. [CrossRef]
70. Dasgupta, P.; David, P.A. Toward a new Economics of Science. *Res. Policy* **1994**, *23*, 487–521.
71. Trajtenberg, M.; Henderson, R.; Jaffe, A. University versus Corporate Patents: A Window on the Basicness of Inventions. *Econ. Innov. New Technol.* **1997**, *5*, 19–50. [CrossRef]
72. Bozeman, B. Technology Transfer and Public Policy: A Review of Research and Theory. *Res. Policy* **2000**, *29*, 627–655. [CrossRef]
73. Feldman, M.P.; Feller, I.; Bercovitz, J.; Burton, R. University Technology Transfer and the System of Innovation. In *Institutions and Systems in the Geography of Innovation*; Feldman, M., Massard, N., Eds.; Kluwer Academic Publishers: Norwell, MA, USA, 2002; pp. 55–77.
74. D'Este, P.; Patel, P. University-Industry Linkages in the U.K.: What Are the Factors Underlying the Variety of Interactions with Industry? *Res. Policy* **2007**, *46*, 1295–1313. [CrossRef]
75. Greek, M.; Jonsmoen, K.M. Transnational academic mobility in universities: The impact on a departmental and an interpersonal level. *High. Educ.* **2021**, *81*, 591–606. [CrossRef]
76. NITI Aayog. Strategy for New India @75. 2018. Available online: https://www.niti.gov.in/sites/default/files/2019-01/Strategy_for_New_India_2.pdf (accessed on 20 December 2022).
77. Working Group Report. Strengthening Academia-Industry Interface (Including Public-Private Partnership) for the 11th Year 5-Year Plan. 2006. Available online: https://dst.gov.in/sites/default/files/rep-saii.pdf (accessed on 28 December 2022).
78. Perkmann, M.; Salter, A. How to create productive partnerships with universities. *MIT Sloan Manag. Rev.* **2012**, *53*, 79–88.
79. Perkmann, M.; Walsh, K. University–industry relationships and open innovation: Towards a research agenda. *Int. J. Manag. Rev.* **2007**, *9*, 259–280. [CrossRef]
80. Plewa, C.; Galan-Muros, V.; Davey, T. Engaging business in curriculum design and delivery: A higher education institution perspective. *High. Educ.* **2015**, *70*, 35–53. [CrossRef]
81. Salleh, M.S.; Omar, M.Z. University-industry collaboration models in Malaysia. *Procedia-Soc. Behav. Sci.* **2013**, *102*, 654–664. [CrossRef]
82. Al-Sultan, K.S.; Alzaharnah, I.T. Academia-industry innovation linkages in the case of Saudi Arabia: Developing a university-industry triple-helix framework to promote research and development collaboration. *Glob. Innov. Index* **2012**, *2012*, 89.
83. Kashyap, A.; Agrawal, R. Academia a new knowledge supplier to the industry! Uncovering barriers in the process. *J. Adv. Manag. Res.* **2016**, *16*, 715–733. [CrossRef]
84. Soam, S.K.; Rathore, S.; Yashavanth, B.S.; Dhumantarao, T.R.; Rakesh, S.; Balasani, R. Students' Perspectives on Entrepreneurship and Its Intention in India. *Sustainability* **2023**, *15*, 10488. [CrossRef]
85. Alves, J.; Marques, M.J.; Saur-Amaral, I. Co-ownership Active Interfaces between Academia and Industry. *Eur. Plan. Stud.* **2007**, *15*, 1233–1246. [CrossRef]
86. Ong, A.K.S. A Machine Learning Ensemble Approach for Predicting Factors Affecting STEM Students' Future Intention to Enroll in Chemistry-Related Courses. *Sustainability* **2022**, *14*, 16041. [CrossRef]

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A Social Networking Analysis of Education Policies of Creating World-Class Universities for Higher Education Sustainability in China

Jian Li and Eryong Xue *

China Institute of Education Policy, Faculty of Education, Beijing Normal University, Beijing 100875, China
* Correspondence: eryongxue@bnu.edu.cn

Abstract: Higher education modernization is a core driver in developing a nation's education. Creating world-class universities is one pathway toward educational modernization in the world's major developed countries and can help meet the challenge of education internationalization and globalization. Thus, the purpose of this study was to investigate world-class universities for higher education sustainability in China through a social networking approach. We aimed to explore the communication path and spatial distribution of social network information about education policies for creation of world-class universities. The core topics discussed by the public were enrollment and employment, followed by the level of institutions and their development. The public in East China discussed the most content, followed by people in North and Southwest China. Positive emotions were mainly found in East, Southwest and North China, while sensitive emotions primarily occurred in East and North China. In addition, the conclusion and implication are offered at the end.

Keywords: world-class universities; higher education sustainability; China's higher education system; social networking approach

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1. Introduction

Modernization of higher education is vital and a key contributor to development of a nation's education [1]. The creation of world-class universities is a way of meeting the challenge of educational modernization in developed countries. At the same time, world-class universities contribute to education internationalization and globalization [2]. The key idea behind education modernization is for countries to put people first and promote overall human development and the sustainable development of society [3]. The diverse and sustainable development of global education leads to comprehensive and systematic education modernization. Innovation, cooperation, openness, and common prosperity are the intrinsic driving forces for the modernization of education in all countries around the world, helping create world-class universities. Attaching importance to quality and fairness is the basic starting point and foothold of global education modernization. The creation of world-class universities also plays an important role in the modernization of world politics, economy, culture, and history [4]. Many studies highlight the significance of exploring world-class universities for higher education sustainability [5]. Actually, creating world-class universities is considered one key strategy for China's higher education institutions to promote superior quality higher education learning outcomes [6]. Based on previous research, the student cultivation, faculty development, campus culture, and institutional management contribute to examining world-class universities in a different contextual background [7–9]. However, there is no previous research on investigating world-class universities for higher education sustainability in China through a social networking approach.

International experience of world-class universities indicates there are internal developmental relations between educational modernization and the market economy, knowl-

edge economy, internationalization, and globalization. Against the background of globalization, education modernization enhances global competition and serves as a buffer to restrain the forces of the global economy. The COVID-19 pandemic, starting from the beginning of 2020, has led to the greatest development crisis since World War II. The pandemic has profoundly affected the macrolevel progress of world-class university creation in China, including the global landscape, relations between countries, the development of society, and political and economic models. Higher education has also been affected. The fight against COVID-19 continues, although it has entered a stage of "normal epidemic prevention." The pandemic is gradually slowing, although high incidence persists in some areas. In this era of COVID-19, restructuring of global political powers, and the rise of new nationalism, the connotation and brand value of Chinese higher education is weak. Lack of global identity will become more marked for higher education in China because international exchanges and cooperation remain limited. Higher education in China faces many external challenges through cutoff from the outside world [10,11].

However, there are few studies on investigating world-class universities for higher education sustainability in China through a social networking approach. Moreover, social network analysis takes social relationship research as the object, studies the relationship and behavior of actors, and explores the potential implicit behavior relationship and pattern by means of data mining. Thus, this study aims to contribute both theoretical and practical explorations of examining education policies through the social networking method. In this context, the purpose of the study was to investigate world-class universities for higher education sustainability in China through a social networking approach. The first section of the paper describes an analysis of policy documents relevant to the creation of world-class universities ("double first-class" universities) in China. The second section describes the communication path and spatial distribution of users' social network information. The results and discussion comprise the third section, followed by the conclusion in the final part.

2. Literature Review of the Idea of University

The idea of university is traditionally discussed by many scholars. *The Idea of a University* is regarded as the first monograph on the basic theory of higher education in the history of modern higher education. John Henry Newman (1801–1890), the author of this book, explained the essence, function, and curriculum of universities, which made it an evergreen tree in the history of higher education and has eternal value in the history of Western higher education and even the history of Western thought [12].

2.1. What Is a University: A Place Where Universal Knowledge Is Taught

In *The Ideal of the University*, Newman started by pointing out that the university is a place where universal knowledge is taught, and it provides an institutional protection force for knowledge, and is the "arbiter of truth" with fairness, inclusiveness, and unity. From this, we can see that Newman's ideal of university starts from his attitude toward knowledge. First, all knowledge is equal and there is no priority sequence. "As knowledge becomes more and more specialized in its degree, the more knowledge. It cannot be called knowledge." "The university is the institutional protection of all knowledge, science, facts and rules, research and discovery, experiment and thought, Universities delineate the sphere of intellectual activity. The boundaries of every field deserve to be respected as if they were religious; Universities are like the arbiters of truth. By examining the characteristics of truth and its main meaning, universities determine their priorities in the sequence of truth [13]."

2.2. What Does a University Do? The Function of a University Is to Teach

Newman's understanding of the functions of universities is based on his understanding of the nature of universities and the nature of knowledge. Since the university is a place where universal knowledge is imparted, then, "on the one hand, the purpose of the

university is rational rather than moral; On the other hand, it aims at spreading and expanding knowledge rather than expanding it. If the purpose of universities is the discovery of science and philosophy, I do not see why they should have students; If the purpose of a university is religious training, I do not see why it should be a hall of literature and science [14]."

2.3. What Is University for? Is University for Human Freedom?

> "University is to realize people's freedom, university education is free education, is for the sake of freedom education; It requires the constant engagement of mind, reason, and reflection; What it needs is the edification of spirit, the promotion of reason and the edification of morality. It requires freedom for the sake of freedom and pursuit for the sake of pursuit [15]."

2.4. What Is Influencing University Development? Socioeconomic Status Dominates

Alam et al. (2021) argue that socioeconomic status dominates prior engineering education to shape further academic and professional achievements. Findings also confirm that more years spent on engineering education fail to offset the influence of SES on academic and professional advancement [16].

In conclusion, the idea of university is associated with knowledge production, teaching, and human freedom development, and is highly affected by socioeconomic status within specific contextual backgrounds. In this study, creating world-class universities in China is considered one key education policy to shape the idea of the modern university in China's current higher education system. Thus, the historical education policy development of creating world-class university is offered, as follows.

3. Key Policy Document Analysis of Creating World-Class Universities ("Double First-Class" Universities) in China

3.1. Overall Plan for Promoting the Construction of World-Class Universities and Disciplines

On 24 October 2015, the State Council issued the "*Overall Plan for Promoting the Construction of World-class Universities and Disciplines*" (the "*Overall Plan*"). The plan points out that the construction of world-class universities and first-class disciplines is a major strategic decision by the CPC Central Committee and the State Council to enhance the level of education development in China. The aim is to enhance the national core competitiveness and long-term development foundation. Implementation of projects such as the "211 project," the "985 project," "advantage discipline innovation platform," and "characteristic key subject project," has enhanced construction of universities and led to major progress in key discipline construction. Overall, the level of higher education in China has increased, and the sustainable and healthy economic and social development has made important contributions to this growth. However, there are problems in key construction, such as identity consolidation, lack of competition, and overlap between institutions. There is an urgent need to strengthen resource integration and develop more innovative implementation methods. For China to make a historic shift to a country of higher education [17], it must consolidate experience, strengthen systematic planning, intensify reform efforts, improve its promotion mechanisms, ensure quality over time, and promote the construction of world-class universities and first-class disciplines.

The Overall Plan lists reform tasks, such as strengthening and improving leadership in colleges and universities. The document indicates adherence to the system of principal responsibility under the leadership of the Party Committee, an intention to establish and improve the working mechanism of unified leadership of the Party Committee, division of labor and cooperation between the Party and the government, a coordinated operation, and constant reform and improvement of the system and mechanism of colleges and universities. The plan acknowledges a need to further strengthen and improve the publicity and ideological work in colleges and universities, firmly grasp the leadership of ideological

work in such institutions, and constantly strengthen the confidence of teachers and students in the path, theory, and system of Chinese socialism.

Further, the document describes a need to comprehensively promote the party in colleges and universities, focus on expanding the coverage of party organizations, promote work innovation, and have colleges and universities play the role of basic-level party organizations by being "fighting fortresses" and vanguards. Corruption must be prevented, and anticorruption discipline processes strengthened to reflect the characteristics of colleges and universities in line with actual working conditions. The responsibility for building party conduct and an ethical government should be taken seriously with strict monitoring and evaluation. This will require improving the internal governance structure, establishing and improving the implementation mechanism of the college charter, and accelerating the formation of a comprehensive, standardized and unified system led by the charter. Academic organizations must be developed, and the academic management system and organizational structure improved through the use of academic committees that give full play to their important role in discipline construction, academic evaluation, academic development, and academic style construction. We need to improve the democratic management and supervision mechanism, expand participation, strengthen discussion and consultation, allow full involvement of faculty, congress, the Communist Youth League, and the Student Union in the democratic decision-making process, and actively explore the mechanism for teacher and student representatives to participate in making decisions for the university [18,19].

3.2. Guiding Opinions on Accelerating the Construction of "Double First-Class" Colleges and Universities

On 8 August 2018, the Ministry of Education, the Ministry of Finance, and the National Development and Reform Commission issued *The Guidance on Accelerating the Construction of "Double First-class" Universities.* It adheres to—and sets out to improve—the responsibility system under the leadership of the Party Committee, enhancing rules and regulations, implementing the university charter, standardizing the internal governance system of universities, promoting a downward shift in management focus, and strengthening the administration of universities according to law. Guidelines suggest a need to innovate grassroots teaching, research organizations, and academic management models. Improvement of the academic governance system will help ensure that teaching and academic committees play an effective role in personnel training and academic affairs. The document calls for establishment and improvement of the school council system, and further improvement of the organizational forms and institutional platforms for social support and participation in school development. Full use of cloud computing, big data, artificial intelligence, and other new technologies is cited to build a comprehensive digital campus support system that improves education [20–23].

3.3. Measures for Evaluating the Effectiveness of "Double First-Class" Construction (Trial)

This document comprehensively details the full implementation of the party's education policy, adhering to the overall party leadership for educational undertakings from a Chinese socialist standpoint. Achievement of world-class outcomes is the focus, through cultivation of first-class talents, actively servicing state needs, overcoming the five main pernicious diseases, and using a "double first-class" construction achievement evaluation system. The third article of this policy points out that the evaluation of the effectiveness of the "double first-class" construction is multidimensional, focusing on the effectiveness of the university and its discipline construction in realizing the university's function and reputational development. It comprehensively presents the results of self-evaluation, expert evaluation, and third-party evaluation of the university. The evaluation includes consideration of Chinese characteristics in the context of world-class education. It considers the direction of education, adherence to the fundamental task of moral education, talent training, team building, scientific research contributions, and mechanism innovation.

To enter the world-class rankings in comparable fields requires more than quantitative indicators. Institutions must be demand-oriented, focusing on service contributions.

Development aims to move colleges and universities to the forefront of world science and technology, economic aspects, and the major national requirements. Higher education institutions are geared to improving people's lives and health, providing breakthroughs in core technologies and frontier sciences, and solving major social problems. Important contributions may range from basic research to important original innovations that investigate the active integration and support of regional and industrial development in specific disciplines. Advances also include the progress made in inheriting and carrying forward traditional Chinese culture, advancing the construction of Chinese socialist culture, promoting the development of human civilization, and innovative and pioneering achievements that open up new fields and directions in governance research [24–26].

Classification evaluation is used to guide development. The document describes the classification and evaluation system for colleges and universities, encouraging these institutions to improve their quality and competitiveness to become first-class in specific fields and directions. The system considers disciplines and follows school-running traditions and development tasks, disciplinary characteristics and cross-integration trends, industry support, and regional services to promote construction through evaluation and focus on continuous improvement. A regular construction monitoring system should be established to enable achievement of construction objectives during the investigation and final period. The extent of development in university disciplines must include third-party evaluation to form a "trinity" approach of monitoring, improvement, and evaluation. Universities are urged to take responsibility for construction, addressing root causes and correcting errors, and continuously improving the level of construction [27,28].

China should adapt its higher education international exchange and strategic focus cooperation to further shape the connotation and characteristics of higher education. This will serve to create world-class universities in the current pandemic situation, strengthening China's cultural identity and the construction of the university community. Effective methods to solve the problem require collaboration with nongovernmental education intermediary organizations for exploration and innovation. The fifth plenary session of the 19th CPC Central Committee proposed to accelerate the construction of a new development pattern with the domestic cycle as the main body and mutual reinforcement from the domestic and international double cycle. In the post-epidemic era, this strategic choice by the Party and the government represents the important situation facing higher education in China. China's higher education has entered the stage of popularization, where unity and diversity coexist. The teaching mode, educational governance, and internationalization of higher education face new challenges, which mean higher education institutions must adapt to the emerging information technology, education management mode changes, and emergency situations. Innovative education internationalization modes are needed to meet the challenges of "reverse globalization." To enable high-quality development in the outbreak era, problems in the higher education system must be addressed, advancing education reform and development [29,30].

4. Methods

4.1. Social Networking Analysis (SNA)

Social network analysis is a quantitative analysis method developed by sociologists based on mathematical methods and graph theory. In recent years, it has been widely used and played an important role in the fields of occupational mobility, the impact of urbanization on individual happiness, the world political and economic system, and international trade. Social network analysis is a mature analytical method in the field of sociology, which can be used by sociologists to explain some sociological problems. Experts in many disciplines, such as economics, management, and other fields, face many challenges in the new economic era—the era of knowledge economy—and begin to consider learning from the research methods of other disciplines; social network analysis is one of them [30].

Network refers to all kinds of connections, and the social network can simply be called the structure of social relations. Social network analysis (SNA) originates from the adaptive network in physics. Through the study of network relations, it is helpful to combine the inter-individual relations and "micro" network with the "macro" structure of large-scale social systems. Through mathematical methods, graph theory, and other quantitative analysis methods, it is a branch of research that gradually developed since the 1970s in the fields of sociology, psychology, anthropology, mathematics, and communication science. From the perspective of the social network, the interaction between people in a social environment can be expressed as a pattern or rule based on relationship, and the regular pattern based on this relationship reflects the social structure. The quantitative analysis of this structure is the starting point for social network analysis. Social network analysis is not only a tool, but also a way of thinking of relational theory. It can be used to explain some problems in sociology, economics, management, and other fields [31]. In 1999, social network analysis, as a diagnostic method to collect and analyze the connection patterns among people in a group, was first introduced into the field of knowledge management by Morten T. Hansen of Harvard University. Weak ties in social networks were used to explain the knowledge transfer within an organization. The results show that weak interunit ties are conducive to the discovery of useful knowledge of other departments, but they are not conducive to the transfer of complex knowledge between departments. Only strong ties can realize the transfer of complex knowledge. In 2000, social network analysis was first proposed as a knowledge management practice by the IBM Institute for Knowledge-based Organizations (IKO) [32].

4.2. Data Collection and Analysis Process

This study applied social network analysis to explore the social relationship research as the object, examine the relationship and behavior of actors, and concentrate on the potential implicit behavior relationship and pattern by means of data mining. During the data collection preparation process, we received approval from the B University Ethical Review Board. In addition, in the data collecting process, we fully considered individual factors, original specific cultural and historical contextual factors, and some relevant social structural factors, such as social culture and political contexts. All these ethical factors contribute to offering a more in-depth understanding of education policies for creating world-class universities in China. Furthermore, considering ethical issues, we comprehensively reviewed relevant narratives, documents, and reports regarding creation of world-class university education policies to make categories and inquiries clearer. Individual factors, organization factors, and structural factors were fully considered in this study [33].

The advantage of the social network analysis is to offer a more large-scale data analysis to examine the macro–micro integration model of education policies for creating world-class universities in specific context. The purpose of this study was to explore the communication path and spatial distribution of social network information. In social networks, data points in different colors represent clusters; therefore, many colors suggest a very large network. The thickness of a line indicates the degree of interaction between two users, with a thicker line indicating more dense communication. The center of a network indicates the status of headlines step-by-step, and the number of users is indicated by the conduction and progressive form of the complexity of the new network. The network's main authority is marked on the map, showing specific intersections between central and external components. This research focuses on the core network of user discussion topics in the cluster, categorizing them for reporting purposes [34].

We collected the data from the National Knowledge Infrastructure (NKI) to select the key words, including "world-class universities," "education policies for creating world-class universities," and "world-class universities construction." The 107 publications, including articles, reports, newspapers, and book chapters, were selected through the NKI. Based on the data collection result, the clustering analysis and emotion classification analysis were conducted as follows:

The clustering results can be roughly divided into three categories: enrollment and employment, institution development, and institution qualification. The TF-IDF algorithm was used to remove irrelevant words and retain significant words. For the enrollment and employment category, significant words included *low ability*, *postgraduate entrance examination*, *employment rate,* and *steppingstones*. Institution development mainly refers to the user's desire for the current situation or an expectation regarding the construction of colleges and universities. Institution qualification refers to discussion about the positioning and qualifications of institutions across regions. Keywords from the "211 project" and the "985 project" were included, such as *western China* and *all kinds of institutions*.

The emotion classification model was applied to analyze the potential emotional keywords and relevant emotion categories. The positive key emotional words include like, agree, support, positive, productive, comfortable, reliable, and truthful, among others. The sensitive key emotional words include critical, dislike, unhappy, worry, upset and uncomfortable, among others. All these specific emotional words contribute to offering a comprehensive pathway to track the social media database [35,36].

5. Results

5.1. Core Topics of World-Class Universities

The core topics discussed by the public were enrollment and employment, followed by the level of institutions and their development. Of these, employment accounted for approximately 32% and enrollment approximately 8% of the discussion (Figures 1 and 2).

5.2. Regional Distribution of Themes

To further clarify the regional distribution of themes, we divided the country into eight regions, with an additional ninth region to cover overseas areas, as shown in Figure 3. The public in East China discussed the most content, followed by people in the North and Southwest regions of the country. Enrollment and employment were the two topics most discussed across regions, followed by the level of colleges and universities. Users held views on the relationship between the level of colleges and universities and enrollment and employment (Figure 3).

5.3. High-Frequency Words in Discussion of World-Class Universities

The public hold some sensitive perceptions regarding the development of double first-class universities. To further clarify these attitudes, we undertook emotional identification of the interaction content of core network clusters to determine the development deficiency and provide some guidelines for the formulation and implementation of relevant policies.

5.4. Emotional Content Analysis of World-Class Universities

In total, 47% of the public showed positive emotions toward the three main themes: 38% had no obvious positive or sensitive emotions, and 15% raised questions about the development. To further explore the differences in public perception of the three topics and the associated emotions, we identified the emotional content of the three themes. Positive emotions dominated the two themes of college level and enrollment and employment, while sensitive emotions increased for the theme of college development. The specific nature of the perceptions toward college development content—and the exact content discussed—requires further detailed study.

Positive emotions were mainly distributed in East China, Southwest China, and North China, while sensitive emotions were mainly found in East and North China. We analyzed the co-occurrence network of relevant high-frequency words to further clarify the main content in terms of sensitive emotions and the spatial interaction of content. For example, some scholars support promoting more effective education policies for creating world-class universities in China's current higher education system. However, there also existed critical opinions on how to balance the educational resource distribution between local and national higher education institutions, contextually [37]. In addition, the discussion

was held around topics relating to" Project 985" and "Project 211"', and public comments reflected the slow development of the western region, and the division of the university into multiple tiers and other issues affecting employment.

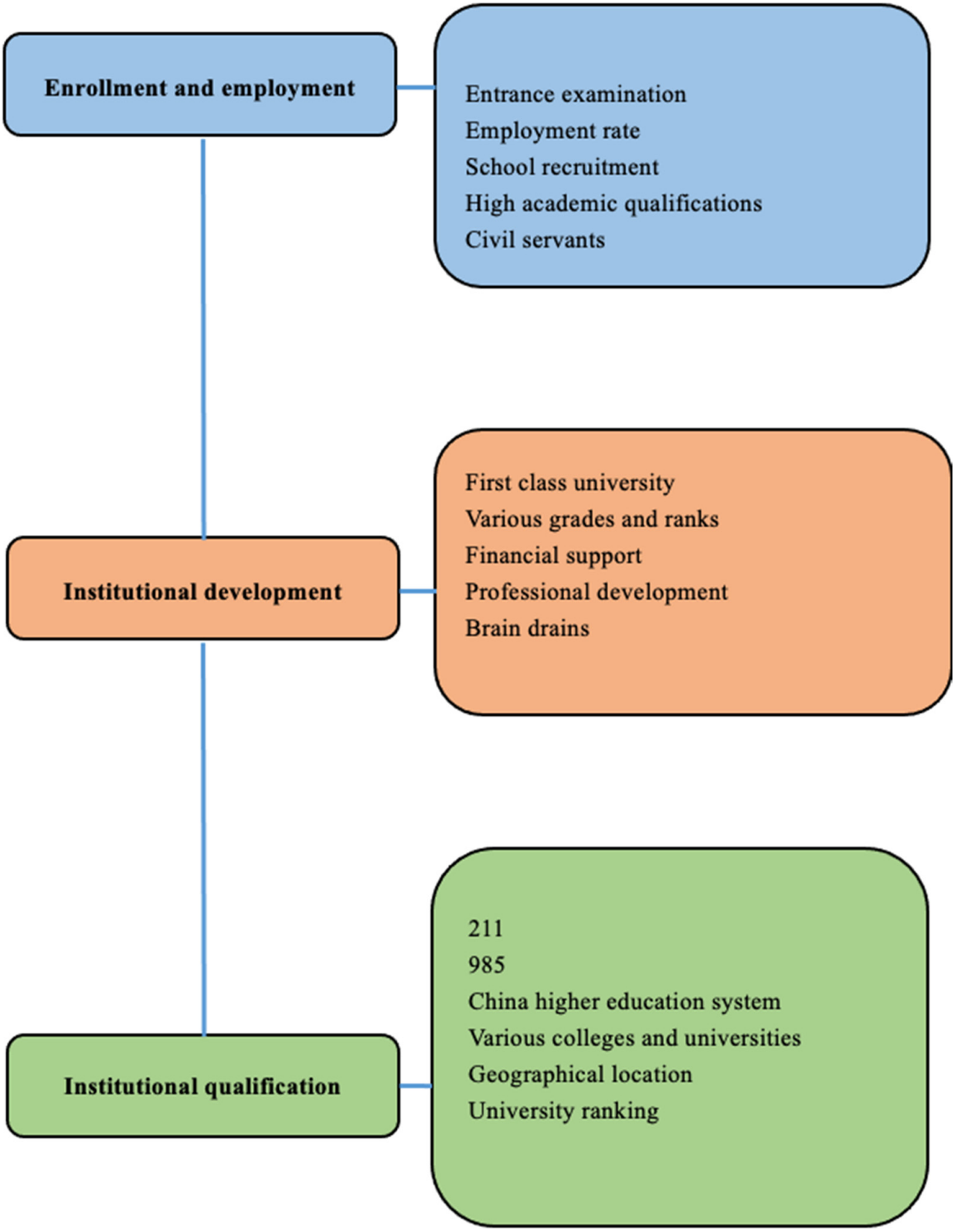

Figure 1. The core topics of world-class universities.

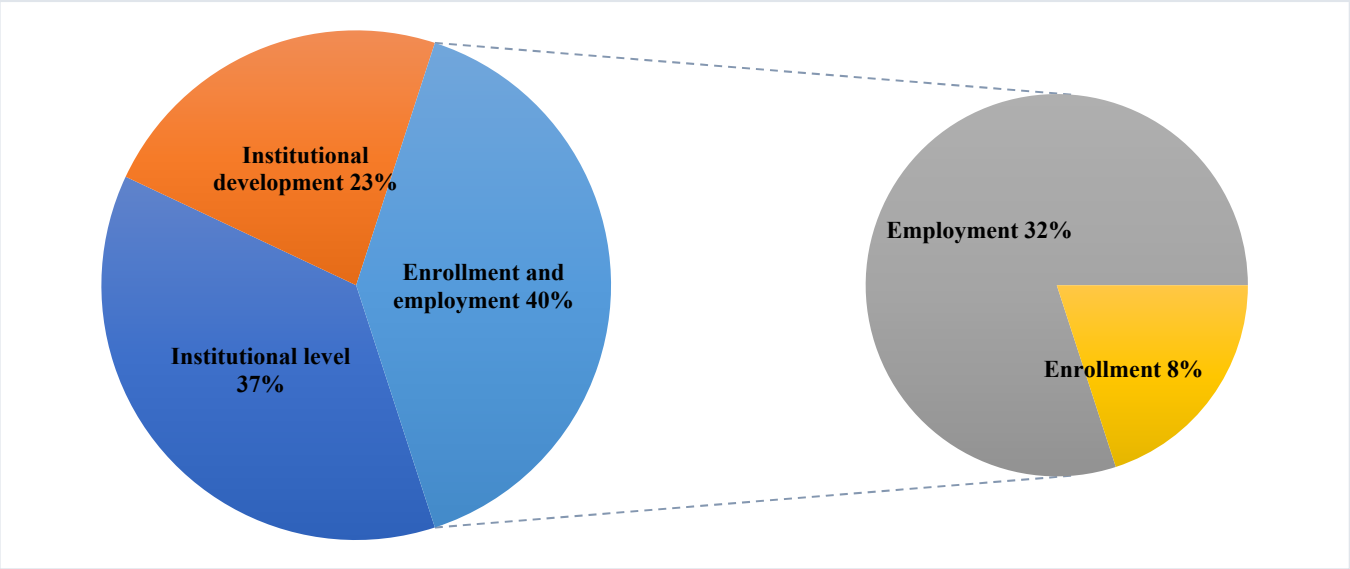

Figure 2. The distribution of core topics of world-class universities.

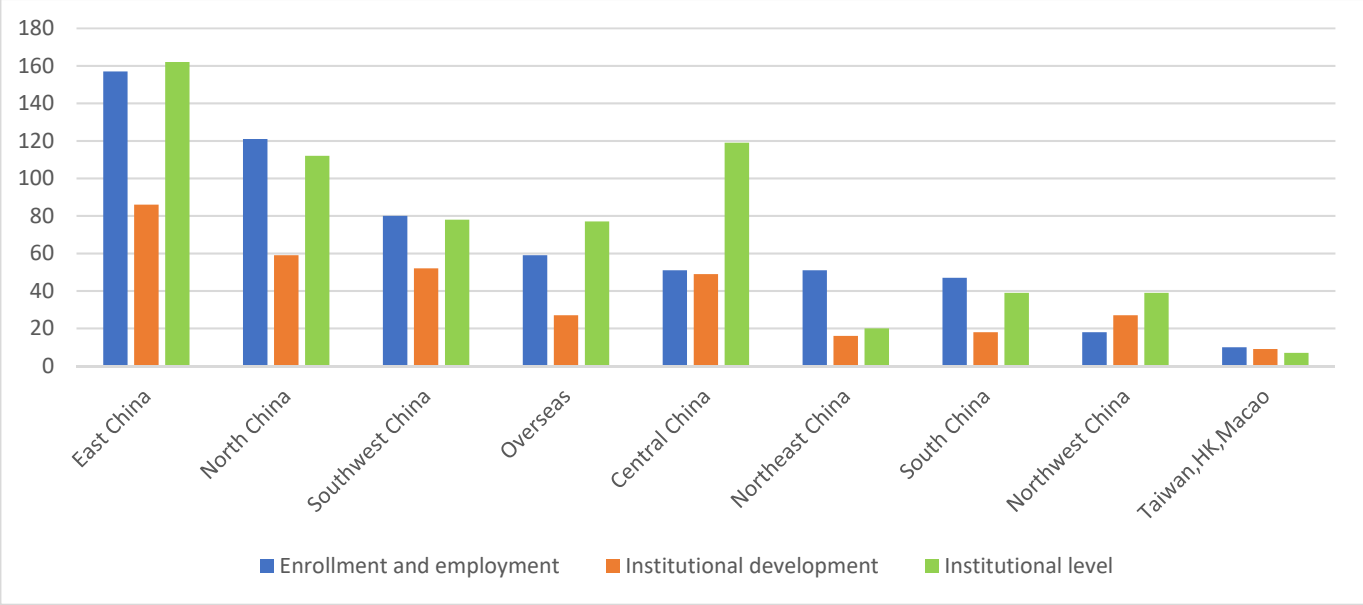

Figure 3. The regional distribution of themes.

6. Discussion and Implications

Along with the results given above, the core topics discussed by the public were enrollment and employment, followed by the level of institutions and their development. The public in East China discussed the most content, followed by people in North and Southwest China. Positive emotions were mainly found in East, Southwest, and North China, while sensitive emotions primarily occurred in East and North China. The current global situation requires further optimization of the overall structure of world-class universities in China, to promote the comprehensive and scientific development of higher education in the country. In the post-epidemic era, China faces both challenges and opportunities to create world-class higher education institutions. Based on the current result, there is a need to promote the balanced allocation of high-quality higher education resources, and to build a higher education layout that meets the needs of regional and industrial development for future regional higher education development in China [38].

6.1. Macrolevel: Domestic and Foreign Background for Optimizing and Adjusting the Structural Layout of World-Class Universities

Concerning the geographical distribution of higher education institutions, many studies have highlighted optimizing and adjusting the structural layout of world-class universities [31–33]. As previous studies noted, a comprehensive and systematic analysis of the current situation and background of the higher education layout locally and abroad will help China construct a forward-looking higher education structure for the new era. Three types of layouts demonstrate how higher education and industrial development can be combined: a regional higher education layout combined with industrial development, an urban higher education layout combined with social development, and a "Bay Area" higher education layout combined with international development. The New York–Boston metropolitan area and university cluster in the United States is an example of the regional higher education layout combined with industrial development. London's construction of a" knowledge city" represents the urban higher education layout combined with social development, while plans for a "super international university" in the Greater Bay Area of Tokyo, Japan, provides an example of a "Bay Area" higher education layout combined with international development. These effective educational layouts provide important references for China in constructing new regional higher education layouts.

Many scholars suggested that understanding the connotations of a higher education layout structure is the first step to explore new layouts combining region and industry [34,35]. The development of higher education layout theory indirectly reflects the historical changes in the development of higher education in China. Based on previous literature, core ideas regarding higher education layouts include the following: First, the theory of external relationship law of education attaches importance to the internal consistency and opposition of higher education and social relationship law. It emphasizes the association and interaction law of higher education and social development. Second, education cost-sharing theory—based on investment benefit sharing and cost-sharing theory—discusses the operational relationship between Chinese universities, local governments, and social capital. The theory of unbalanced development notes that the development of regional higher education is relatively weak, and the discipline construction and campus security facilities do not match the plans for development of regional higher education. The third functional theory suggests that colleges and universities function to cultivate talent, combine teaching and scientific research, and develop talent output and social services.

6.2. Mesolevel: The Challenge of Creating a World-Class University Structural Layout in China

Some previous studies found that there were some challenges to creating a world-class university structural layout in China's current higher education system [39,40]. For example, the analysis of the distribution of world-class universities in China is conducive to the overall construction of regional educational development and a structural model of world-class universities with Chinese characteristics. The present situation and problems with higher education distribution include: the mechanism of construction and innovation of regional higher education development in China, the allocation of resources for regional higher education development, and the construction of regional college clusters in China. These aspects are discussed from three perspectives: national strategic positioning, regional development positioning and supporting service positioning.

Many previous studies suggested that, first, the system of higher education development mechanism innovation urgently needs to improve. The higher education distribution strategy in China focuses on the distribution of universities in central, western, and eastern regions. The current layout of colleges and universities in China lacks the development mechanism innovation consciousness to serve the national strategy. The system requires updating to keep pace with the times. The layout of colleges and universities lacks a clear definition, has an outdated development mechanism, and is disconnected from the overall layout of the country. Second, the overall layout of higher education resource reallocation needs to be optimized. At present, the distribution of higher education resources in China

is unbalanced. The difference in higher education resources between regions is large, and the overall resource allocation structure is poor, seriously affecting the overall distribution of higher education resources across the country. Third is the formation of the university cluster. The construction of regional higher education clusters in China is based on the orientation of higher education support services. China's university clusters need to be further developed because the regional university clusters lack overall coordination and cooperation, and the integrated development mechanism of university clusters has not been established [41].

6.3. Microlevel: New Trend of Optimizing and Adjusting the Structure of World-Class Universities

Previous studies suggested that there are some new trends for optimizing and adjusting the structure of world-class universities in current higher education context. [38,39]. Analysis of the dynamic trend of world-class higher education layouts is key in supporting construction of an education layout that adapts to regional and industrial development. First, institutions and mechanisms can be reformed to build demonstration zones, innovation zones, and pilot zones. The urban and rural development strategy drives the regional spatial distribution of higher education to build innovative institutions and mechanisms and establish a comprehensive system and mechanism innovation model. Second, we need to give priority to the layout of characteristic industries: the newly added resources are focused on urban industrial agglomeration areas. To prioritize the distribution of specific industries, we need to focus resources on urbanization and industrial agglomeration and build a new pattern of regional higher education with urbanization and industrial agglomeration areas as the core. The proposed new urbanization plan promotes the rise of characteristic industry patterns in the regional higher education layout. Optimizing the layout of specific industries can be carried out in a step-by-step way, giving priority to the layout of the industrial structure, space, and functions. Third, the development of industry-specific universities is concerned with the establishment of application-oriented, small-scale characteristic colleges. The focus is on developing universities with industry characteristics and giving play to the rationality of regional university layout structure. We can further promote the fair, coordinated, and comprehensive development of education between regions; establish application-oriented and small-scale colleges; and promote the comprehensive development of the regional economy and urban–rural integration through the construction of a regional university layout with industry characteristics [42,43].

7. Conclusions

This study aimed to investigate world-class universities to understand higher education sustainability in China using a social networking approach. Through a series of analysis of education policies concerning creation of world-class universities, we found there is an obvious unbalanced layout of world-class universities in China's current higher education system. The unbalanced distribution of higher education institutions caused different educational resource allocations, such as financial support, faculty distribution, and student cultivation. In addition, there still exist some indisputable challenges and opportunities to shape high-quality universities and college locally and nationally. We explored the communication path and spatial distribution of social network information on the education policies regarding creation of world-class universities in China [44,45]. China should focus on the development of world-class universities and the monitoring and evaluation of the quality of higher education, especially the innovation of educational modes and expansion of quality education resources. In the post-epidemic era, there are both challenges and opportunities to create world-class higher education institutions. During the COVID-19 pandemic, online education and network education developed rapidly, and MOOCs, for example, have the potential to advance China's internationalization of higher education in the future [26,46–50].

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References

1. Yang, R.; Welch, A. A world-class university in China? The case of Tsinghua. *High. Educ.* **2012**, *63*, 645–666. [CrossRef]
2. Luo, Y. Building world-class universities in China. In *Institutionalization of World-Class University in Global Competition*; Springer: Dordrecht, The Netherlands, 2013; pp. 165–183.
3. Song, J. Creating world-class universities in China: Strategies and impacts at a renowned research university. *High. Educ.* **2018**, *75*, 729–742. [CrossRef]
4. Huang, F. Building the world-class research universities: A case study of China. *High. Educ.* **2015**, *70*, 203–215. [CrossRef]
5. Ngok, K.; Guo, W. The quest for world class universities in China: Critical reflections. *Policy Futures Educ.* **2008**, *6*, 545–557. [CrossRef]
6. Li, J.; Xue, E. Returnee faculty responses to internationalizing "academic ecology" for creating world-class universities in China' elite universities. *High. Educ.* **2021**, *81*, 1063–1078. [CrossRef]
7. Li, J.; Li, J. Educational policy development in China in the 21st century: A Multi-Flows Approach. *Beijing Int. Rev. Educ.* **2019**, *1*, 196–220. [CrossRef]
8. Do, H.T.H.; Mai, A.N. Role of the government in the establishment of world-class universities in China. *Policy Futur. Educ.* **2022**, *20*, 12–19. [CrossRef]
9. Li, J.; Xue, E. The Scientific Research of Creating World-Class Universities in China. In *Creating World-Class Universities in China*; Springer: Singapore, 2021; pp. 91–113.
10. Li, J.; Xue, E. The Data Analysis of Creating World-Class Universities in China. In *Creating World-Class Universities in China*; Springer: Singapore, 2021; pp. 35–52.
11. Li, J.; Xue, E. Exploring High-Quality Institutional Internationalization for Higher Education Sustainability in China: Evidence from Stakeholders. *Sustainability* **2022**, *14*, 7572. [CrossRef]
12. Newman, J.H.; Landow, G.P.; Newman, J.E.; Turner, F.M.; Garland, M.M.; Castro-Klaren, S. *The Idea of a University*; Yale University Press: New Haven, CT, USA, 1996.
13. MacIntyre, A. The very idea of a university: Aristotle, Newman and us. In *Education Matters*; Routledge: London, UK, 2012; pp. 251–265.
14. Alam, G.M. Do Urbanized Socioeconomic Background or Education Programs Support Engineers for Further Advancement? *Int. J. Educ. Reform* **2021**, *30*, 344–360. [CrossRef]
15. Alam, G.M.; Forhad, M.; Rahman, A. What makes a difference for further advancement of engineers: Socioeconomic background or education programs? *High. Educ.* **2022**, *83*, 1259–1278. [CrossRef]
16. Alam, G.M.; Forhad, M.A.R. Roadblocks to university education for diploma engineers in Bangladesh. *High. Educ. Ski. Work. Based Learn.* **2021**, *11*, 59–77. [CrossRef]
17. Li, J.; Xue, E. The Internationalization of Creating World-Class Universities in China. In *Creating World-Class Universities in China*; Springer: Singapore, 2021; pp. 163–175.
18. Allen, R.M. Commensuration of the globalised higher education sector: How university rankings act as a credential for world-class status in China. *Comp. J. Comp. Int. Educ.* **2021**, *51*, 920–938. [CrossRef]
19. Li, J.; Xue, E. The Student Cultivation of Creating World-Class Universities in China. In *Creating World-Class Universities in China*; Springer: Singapore, 2021; pp. 71–90.
20. Zhu, X.; Li, J. Conceptualizing the ontology of higher education with Chinese characteristics. *Educ. Philos. Theory* **2018**, *50*, 1144–1156. [CrossRef]
21. Li, J.; Xue, E. How talent cultivation contributes to creating world-class universities in China: A policy discourse analysis. *Educ. Philos. Theory* **2021**, *23*, 1–10. [CrossRef]

22. Oleksiyenko, A.; Liu, J. Pursuing Policy Alignments for World-Class Economic and Educational Performance in the Greater Bay Area of China. In *Third International Handbook of Globalisation, Education and Policy Research*; Springer: Cham, Switzerland, 2021; pp. 209–240.
23. Wan, X. The problem and future of the higher education quality assessment system in China-Reflection on the Double World-Class Initiative. *Acad. J. Humanit. Soc. Sci.* **2021**, *4*, 54–60.
24. Qin, M.; Wu, J.; Chen, C.; Zhao, J.; Yang, Y. Suggestions for university journals under the background of developing world-class scienpngic journals: Based on the analysis of China High-Quality Scienpngic Journal Rating Guide. *Chin. J. Sci. Tech. Period.* **2021**, *32*, 613.
25. Wu, S.; Zhou, S.; Huang, M.; Chen, W. Employment Prospects of Graduates From Sino-Foreign Cooperative Universities in China. *J. Stud. Int. Educ.* **2022**, *26*, 21–43. [CrossRef]
26. Mok, K.H.; Marginson, S. Massification, diversification and internationalisation of higher education in China: Critical reflections of developments in the last two decades. *Int. J. Educ. Dev.* **2021**, *84*, 102405. [CrossRef]
27. Han, S. Empowered or disempowered by mobility? Experience of international academics in China. *Stud. High. Educ.* **2022**, *47*, 1256–1270. [CrossRef]
28. Jian, G.; Tian, Y.; Li, Y. Internal Governance Structure of "Double First-class" Universities in China. *J. High. Educ. Theory Pr.* **2022**, *22*, 35–46.
29. Huang, X.; Yu, P.; Song, X.; Chen, H. Strategic focus study on the new development pattern of 'dual circulation' in China under the impact of COVID-19. *Transnatl. Corp. Rev.* **2022**, *14*, 169–177. [CrossRef]
30. Loyalka, P.; Liu, O.L.; Li, G.; Kardanova, E.; Chirikov, I.; Hu, S.; Yu, N.; Ma, L.; Guo, F.; Beteille, T.; et al. Skill levels and gains in university STEM education in China, India, Russia and the United States. *Nat. Hum. Behav.* **2021**, *5*, 892–904. [CrossRef] [PubMed]
31. Li, J. The global ranking regime and the reconfiguration of higher education: Comparative case studies on research assessment exercises in China, Hong Kong, and Japan. In *Measuring Up in Higher Education*; Palgrave Macmillan: Singapore, 2021; pp. 177–202.
32. Xue, E.; Tian, S.; Li, J. Doctoral cultivation system and mechanism of university think tank in China. *Educ. Philos. Theory* **2022**, *25*, 1–10. [CrossRef]
33. Sifaki, E.; Petousi, V. Contextualising harm in the framework of research misconduct. Findings from discourse analysis of scientific publications. *Int. J. Sustain. Dev.* **2020**, *23*, 149–174. [CrossRef]
34. Xue, E.; Li, J. Exploring the education power in China: The basic connotation, key index, and strategic pathway. *Educ. Philos. Theory* **2022**, *20*, 11–18. [CrossRef]
35. Freeman, L.C. The Development of Social Network Analysis. *Study Sociol. Sci.* **2004**, *1*, 159–167.
36. Scott, J. Social network analysis. *Sociology* **1988**, *22*, 109–127. [CrossRef]
37. Knoke, D.; Yang, S. *Social Network Analysis*; SAGE publications: Thousand Oaks, CA, USA, 2019.
38. Marin, A.; Wellman, B. Social network analysis: An introduction. *SAGE Handb. Soc. Netw. Anal.* **2011**, *11*, 25.
39. Scott, J. Social network analysis: Developments, advances, and prospects. *Soc. Netw. Anal. Min.* **2011**, *1*, 21–26. [CrossRef]
40. Tichy, N.M.; Tushman, M.L.; Fombrun, C. Social Network Analysis for Organizations. *Acad. Manag. Rev.* **1979**, *4*, 507–551. [CrossRef]
41. Xue, E.; Li, J. Cultivating high-level innovative talents by integration of science and education in China: A strategic policy perspective. *Educ. Philos. Theory* **2021**, *54*, 1–12. [CrossRef]
42. Fan, F.; Liu, X. Recruiting Overseas Talents to Universities in Mainland China: Study of a "Double First-Class Initiative" College. *Chin. Educ. Soc.* **2021**, *54*, 130–140. [CrossRef]
43. Yu, Y.; Cheng, M.; Xu, Y. Understanding international postgraduate students' educational mobility to China: An ecological systematic perspective. *High. Educ. Res. Dev.* **2021**, *20*, 1–17. [CrossRef]
44. Li, J.; Xue, E. Rethinking how to create world-class universities in China: A policy mapping perspective. *Educ. Philos. Theory* **2022**, *54*, 81–91. [CrossRef]
45. Sun, C.; Liu, J.; Razmerita, L.; Xu, Y.; Qi, J. Higher Education to Support Sustainable Development: The Influence of Information Literacy and Online Learning Process on Chinese Postgraduates' Innovation Performance. *Sustainability* **2022**, *14*, 7789. [CrossRef]
46. Mo, L.; Zhu, Y. How Is Alumni Giving Affected by Satisfactory Campus Experience? Analysis of an Industry-Research-Oriented University in China. *Sustainability* **2022**, *14*, 7570. [CrossRef]
47. Zhuang, T.; Liu, B. Sustaining Higher Education Quality by Building an Educational Innovation Ecosystem in China—Policies, Implementations and Effects. *Sustainability* **2022**, *14*, 7568. [CrossRef]
48. Han, S.; Xu, X. How far has the state 'stepped back': An exploratory study of the changing governance of higher education in China (1978–2018). *High. Educ.* **2019**, *78*, 931–946. [CrossRef]
49. Luo, Y.; Guo, F.; Shi, J. Expansion and inequality of higher education in China: How likely would Chinese poor students get to success? *High. Educ. Res. Dev.* **2018**, *37*, 1015–1034. [CrossRef]
50. Li, F. The Expansion of Higher Education and the Returns of Distance Education in China. *Int. Rev. Res. Open Distrib. Learn.* **2018**, *19*, 4. [CrossRef]

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Sustainable Assessment Tools for Higher Education Institutions: Developing Two-Hierarchy Tools for China

Yawei Du [1,2,*], Qing Ye [3], Hongjiang Liu [4], Yuting Wu [4] and Fenghua Wang [5,*]

[1] Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China
[2] Shenzhen Development Research Center for Real Estate and Urban Construction, Shenzhen 518000, China
[3] School of Architecture and Art Design, Hebei University of Technology, Tianjin 300130, China; 2019101@hebut.edu.cn
[4] School of Architecture, Tianjin University, Tianjin 300072, China; hongjiang@tju.edu.cn (H.L.); kely-wuyuting@outlook.com (Y.W.)
[5] Faculty of Electrical Engineering, Mathematics and Computer Science, Delft University of Technology, 2628 CD Delft, The Netherlands
* Correspondence: duyawei@whu.edu.cn (Y.D.); f.wang-8@tudelft.nl (F.W.)

Abstract: Higher Education Institutions (HEIs) play an increasingly significant role in the practice of sustainability. For HEIs in their early stages of sustainability, they are still in need of sustainable assessment tools (SATs) that are suitable for their local context and also lead international sustainable development. The purpose of this paper is to develop a two-hierarchy sustainability assessment tool (THSus) for Chinese higher education institutions, including a quick analysis tool (QAT) and an in-depth benchmarking tool (IBT). The QAT provided a general overview of campus sustainability for HEIs to initiate initial actions and screen cases for the IBT. The IBT then provides more targeted analysis to plan long-term strategic changes. Based on the analysis of HEI cases, a 34-person Chinese research team was enlisted to discuss and select characteristics to formulate THSus. Indicators and weightings were developed according to the tool's purpose and applied to 15 cases to test its effectiveness. Results showed that THSus is suitable for systematically analyzing campus issues, particularly in research areas. It offers a regional solution for Chinese campuses that is adaptable and considers the comprehensive core of sustainability.

Keywords: campus sustainability; green campuses; higher education institution; sustainable assessment tools; two-hierarchy tools

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1. Introduction

The global commitment to sustainability is attracting increasing attention [1], and strong commitments are needed for countries to take action to create a shared sustainable future. In the context of education, sustainability in education refers to programs that aim to protect the environment and promote the responsible use of natural resources [2,3]. The 40th UNESCO World Conference outlines the framework to achieve the 17 Sustainable Development Goals (SDGs) by 2023 through sustainability education [4]. Therefore, HEIs play a crucial role in achieving a sustainable future [5].

HEIs are mini-cities [6] for promoting and practicing sustainable development (SD) strategies [7,8]. They also have a positive impact on students' knowledge and attitudes towards SDGs through sustainability-oriented education and activities [9]. A sustainable HEI campus not only represents the implementation of environmental science but also shows the interaction between the environmental, social, and economic factors [10,11], engaging a broad range of stakeholders [12].

Sustainable assessment is one of the initial steps for HEIs to take action toward sustainability [13]. A number of SATs have been developed for HEI campuses in regional and international contexts, but few regional tools exist for campuses in the early stages

of sustainability [14]. On the one hand, it is of great importance for the proposal of the international SATs to explore the common guiding goals in the sustainability of HEIs. On the other hand, it is of practical importance to develop regional SATs to adapt to the local context and bridge the gaps between HEIs in different stages [15].

By May 2022, there were 2759 regular HEIs in China and 272 HEIs in Beijing–Tianjin–Hebei, accounting for about 10% of the total number. Chinese campuses have evolved from energy efficacy campuses in the 1990s to more comprehensive green campuses today [16]. The green campus is similar to the sustainable campus [17]. To encourage the construction of the green campus, the Ministry of Housing and Urban-Rural Development (MOHURD) and the Ministry of Education (MoE) have funded more than 300 HEIs [18] as demonstration campuses for the application of the Campus Energy Management Systems (CEMS) [19].

Previous studies have compared international SATs with Chinese campuses and have found that modifications are necessary to consider the actual status of campus sustainable development in China [17,20]. Additionally, regional case studies have been conducted to propose more appropriate SATs for Chinese HEIs [21,22]. In general, Chinese HEIs are still in their early stage of sustainability and in need of regional SATs. The MOHURD has supported to release the Evaluation Standards for Green Campus 2013 CSUS/GBC 04-2013 and the updated version of the Assessment Standard for Green Campus 2019 GBT 51356-2019 (ASGC) [23,24] to lead Chinese campus towards sustainability [25]. But no official campus assessment report has been published. It is challenging for campuses in their initial stages to adopt the ASGC because of the lack of data for assessment. Much effort is still needed for HEIs to enroll in assessments and take action toward more comprehensive green campuses [22].

This paper aims to propose a sustainable campus framework and two-hierarchy tool (THSus) for China, especially for the HEIs in Beijing–Tianjin–Hebei. The two-hierarchy tools included a quick analysis (30 indicators) tool and an in-depth (70 indicators) benchmarking tool. The quick SAT offered a general picture of the HEIs' sustainable performance and was developed for HEIs at all stages of sustainability, while the in-depth SAT aims to offer a systematic benchmarking and applies to the campuses with a certain basis for SD. To develop the two-hierarchy tools, 15 HEI cases in Beijing–Tianjin–Hebei were selected for analysis. And combined with the current situation of the HEIs and the characteristics of the existing SATs, with the assistance of a 34-person expert team, the framework, indicators, and weightings were proposed to formulate the tools. Then, the tools were applied to the 15 HEI cases to see their assessment results.

This research contributes to enrolling Chinese HEIs in sustainable assessment and could be helpful for HEIs at the early stage of SD to learn from the process of the assessment and potentially improve the sustainability by enrolling or developing more applicable regional SATs. The 15 cases and their assessment results also provided valuable empirical data to draw a more in-depth picture of HEI SD in Beijing–Tianjin and Hebei.

2. Research Area

2.1. The Beijing–Tianjin–Hebei

Beijing–Tianjin–Hebei, one of the most important city clusters in China, faced with common challenges towards sustainability, is selected as the research area. There were 272 regular HEIs in the research area, with 2.0943 million students and a total building area of 94.52 million square meters [26].

2.2. The HEI Cases

In order to select representative HEI cases in Beijing–Tianjin–Hebei, first a brief analysis of Chinese higher education was made to learn the basic characteristics of the campuses. Since the foundation of the People's Republic of China, higher education has experienced a development process of more than 70 years, and campuses have been exploring planning and designing methods for sustainability [27].

The SD periods of the HEI green campuses and basic characteristics of campuses (Table 1) were considered to select the cases of the HEIs [28,29]. And both green campus demonstration campuses that applied Campus Energy Management Systems (CEMS) and non-demonstration campuses have been included. Finally, based on the comprehensive consideration of the accessibility and adequacy of data, 15 cases were selected for further analysis (Table 2).

Table 1. Characteristics of the Chinese HEIs.

Characteristics	Types	Description
Sustainable development periods	The Exploration Period (campuses built before 1949)	Historical campuses faced with problems such as old infrastructure, disrepair of buildings, mismatch between original functions and current development, etc.
	The Enlightenment Period (campuses built between 1949 and 2006)	The concept of green development is not clearly defined, and campuses had been influenced by various planning ideas to explored the SD.
	The Developing Period (campuses built after 2006)	After the release of Evaluation Standards for Green Campus 2013 (CSUS/GBC 04-2013), some new built green campuses based on systematic planning and construction have emerged.
Campus area (hectares) [1]	XS	$0 < S \leq 25$
	S	$25 < S \leq 50$
	M	$50 < S \leq 100$
	L	$100 < S \leq 200$
	XL	$200 < S \leq 500$
	XXL	$S > 500$
Location	C	Central urban area
	S	Suburban area
Development mode	redevelopment (R)	On the basis of no obvious changes in the original site and boundary, the campuses have been transformed and renewed.
	Expansion (E)	On the basis of the original site, the surrounding land is absorbed to expand the campuses boundary.
	Multi-campus operation (M)	There are two or more campuses in different locations that share the daily teaching and research activities.

[1] A total of 189 out of 271 HEIs with accessible official data were considered according to the hectare. And the biggest campus has been included.

Table 2. Basic information of the selected HEIs cases in Beijing, Tianjin, and Hebei.

Period	Cases Abbreviation [1]	CEMS Demonstration	Discipline Type	Campus Area and Location	Development Mode
The Exploration Period	1THU	Y	Comprehensive	XL (C)	E
	2NKUU	Y	Comprehensive	L (C)	R and M
The Enlightenment Period	3TJUU	Y	Technology	L (C)	R and M
	4CUMT	Y	Technology	S (C)	R and M
	5MUC	Y	Nationalities	S (C)	R and M (In construction)
	6HEBUT	Y	Science and Technology	L (C)	R and M

Table 2. *Cont.*

Period	Cases Abbreviation [1]	CEMS Demonstration	Discipline Type	Campus Area and Location	Development Mode
	7BUA	N	Agriculture	M (C)	R
	8TFSU	N	Language	S (C)	R and M
	9TJCM	N	Art	S (C)	R
	10TJCM	Y	Finance	S (C)	R
	11HSU1	N	Sports	S (S)	R and M
	12CUGGW	N	Science and Technology	S (S)	R
	13LTU1	N	Normal	S (C)	M
The Development Period	14TJU2	Y	Science and Technology	XL (S)	M
	15NKU2	Y	Comprehensive	XL (S)	M

[1] The number after the HEIs abbreviations represent the branch campuses.

3. Methodology

The construction, transformation, application, and update of the SATs can be summarized in a systematic manner, considering the specific context [22,30,31]. Initially, it is crucial to review and compare existing SATs as a basis for either applying or constructing new SATs. Alternatively, if the existing SATs are only partially relevant, SATs could be modified or developed based on the characteristics of the existing SATs and the requirements of the local HEIs.

In order to create a sustainable assessment framework that was both leading campuses toward sustainability and more adaptable to the Beijing–Tianjin–Hebei local context, a mixed method was used. The design process was developed based on the review of SATs and considering the local contexts. The process goes as follows (Figure 1).

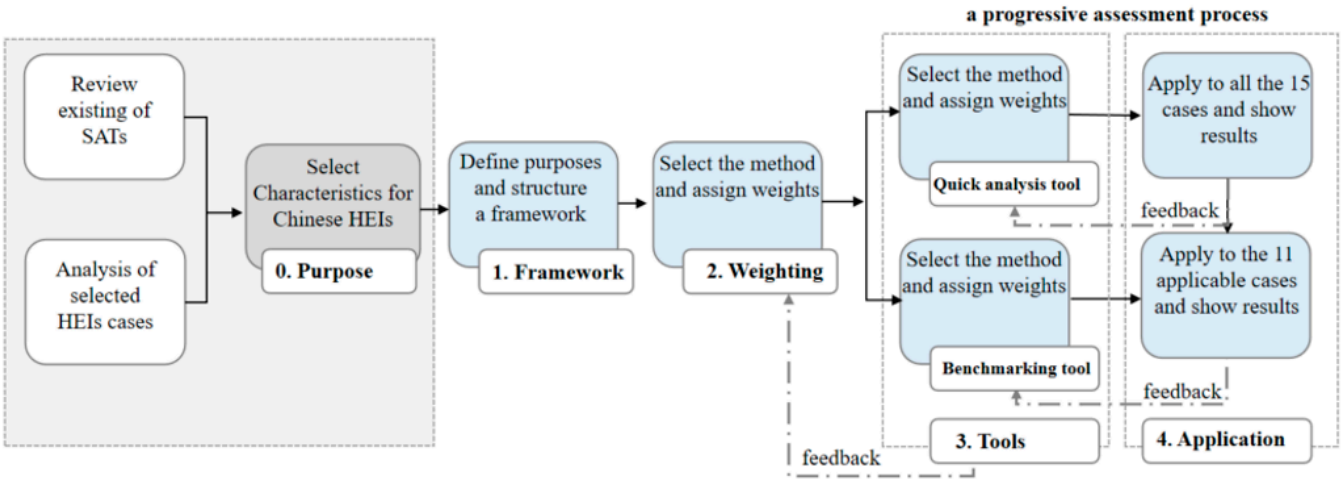

Figure 1. Process for developing the thus for the HEIs in Beijing, Tianjin, and Hebei.

In our previous study, 15 existing SATs have been selected and reviewed to make comparison of their purpose and stages, weightings, and assessment content in the level of indicators. This comparison helped us identify guidelines and assessment purposes that could be used to formulate the Chinese SATs [15].

Based on general guidelines and components of the Chinese SAT, according to the analysis of the HEIs cases, through the enrollment of a 34-person Chinese research team, this study developed the two-hierarchy tools in four steps: framework construction, weight-

ing, tool development, and application. In each step, the main problems faced by HEIs in achieving sustainability have been identified and analyzed. Possible solutions were proposed, taking inspiration from existing SATs. These solutions were further improved by involving the research team or validating them through HEI cases. These solutions aim to find more practical and effective approaches for the assessment of the researched area.

The Chinese research team was involved in discussing and selecting characteristics to formulate the new framework and develop tools for the research area. The research team invited targeted experts from our network and those who have published papers related to campus sustainability between 2018 and 2020. A total of 34 experts were selected, including researchers, designers, engineers, senior managers, faculty leaders, and government officers from 14 institutes (eight HEIs, four research and design institutes, and two planning bureaus).

3.1. Framework

First, the proposed guidelines for Chinese SATs were studied in our previous analysis [15]. The study involved selecting 15 SATs out of 73 that were identified from 24 articles reviewing HEI SATs. The screening process was conducted using Scopus and Web of Science and was supported by the PRISMA statement. The selected SATs were then analyzed to identify important components for developing SATs. Based on these components, guidelines for the Chinese SAT were formulated through an online workshop. The guidelines for Chinese SATs were proposed as follows.

Chinese campuses are still in their early stage of SD and in need of a tool or toolkit for identifying the overall sustainability picture, benchmarking, and strategy making. And this paper aimed to develop two-hierarchy tools, in response to the first two purposes. The current ASGC has the highest emphasis on the environmental operations of the 15 SATs, which is recommended to move to a more balanced emphasis that aligns with the core of sustainability.

Second, the current situation of HEI cases was studied to better select the components for the SATs. These cases include HEIs of different basic characters and SD levels. And the general understanding of the main problems they faced towards sustainability was as follows.

- In terms of the environmental aspect, the CEMS demonstration campuses have adopted relatively more in-depth and extensive green design and renovation measures, but the SD of the non-demonstration campuses is at a relatively early stage.
- In terms of the social aspect, most of the campuses have carried out green education and related research, but the engagement of teachers and students was relatively insufficient. Sustainable campuses needed to be shared in order to be adopted and uniformly implemented across institutions [32].
- In terms of the economic aspect, in addition to funding from the CEMS project, some campuses are actively seeking support through energy management contracts, collaboration with government agencies, etc. In most cases, however, the long-term financing of SD remains a challenge.

Based on the review of existing SATs and the analysis of the Chinese campus cases, a new framework was proposed.

Campus sustainability has been defined in various studies [9,33,34]. The term 'sustainability in higher education' was first mentioned in the Stockholm Declaration of 1972. This declaration emphasized the connection between humanity and the environment [34]. As environmental issues become increasingly complex, campus sustainability focuses on the underlying principles of sustainability rather than just addressing the environmental issues. It bridges the Sustainable Development Goals (SDGs) with education, recognizing the interconnectedness between education and sustainability. It also addressed the importance of sustainability in education which refers to the education programs that aim to protect the environment and promote the responsible use of natural resources [3].

The framework started from the main functions of HEIs, engaging the main internal stakeholders of HEIs, adopted the core dimensions of sustainability, and responded to the solutions in the local context, with three core dimensions of (1) built environment, (2) operations, and (3) participation (Figure 2).

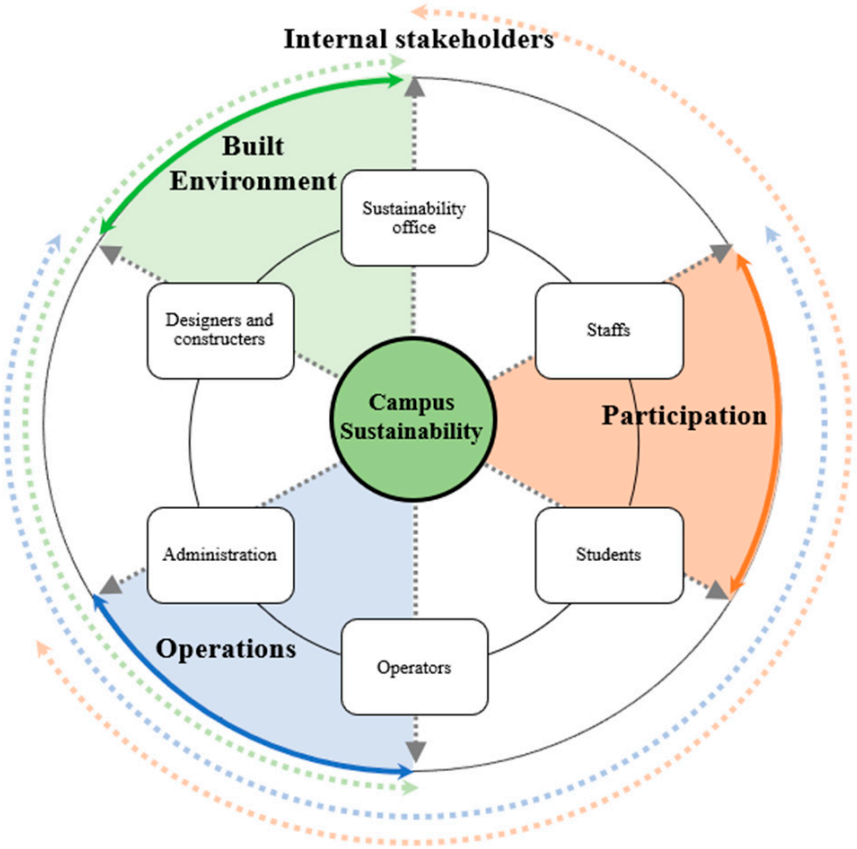

Figure 2. Sustainability dimensions and main internal stakeholders linked to the HEI system.

3.2. Indicators

The indicators of the tools were selected in two rounds. In the first round, 70 indicators were selected or modified to express the comprehensive core and leading roles of campus sustainability quantitively to develop the in-depth benchmarking tool. In the second round, 30 indicators were selected based on the 70 indicators and simplified to well express the core of campus sustainability and adaptability to campuses in all stages of SD to qualitatively develop the quick analysis tool.

According to the topics and issues selected by the expert's team, the indicators were selected or modified from the Chinese ASGC, Sustainability Tracking, Assessment and Rating System for Colleges and Universities (STARS) [35], Assessment System for Sustainable Campus (ASSC) [36], World University Rankings (GM) [37], Greening Universities Toolkit (Toolkit) [38], and Assessment Instrument for Sustainability in Higher Education (AISHE) [39].

The principles [40–42] of the selection of the indicators were as follows.

- The indicators demonstrate coverage of key campus sustainability themes and issues. They are relevant to users, decision-makers, and local and global sustainability challenges.
- They are linked to a clear objective and reflect the university's capacity to effect change.
- They are adaptable to the local context and based on accurate, available, and accessible data of known quality.

3.3. Weighting

The review of the SATs suggested that the weighting of the Chinese SAT should be more balanced compared to the overemphasis on environmental factors in ASGC. Then, the weights of the tool have been assigned to the dimensions and aspects with the analytic hierarchy process (AHP) weighting method. The weights should reflect the analysis and judgment of the value of the dimensions and aspects and reflect the scientific nature of the indicator system [43,44]. Therefore, the expert team was invited to integrate a wide range of stakeholders and practical experience related to campus sustainability in Beijing–Tianjin–Hebei, and 25 out of 34 experts were enrolled to assign weightings to aspects using the analytic hierarchy process (AHP). After two rounds of the interactive process, the AHP weightings were proposed.

3.4. Developing the Tools

Next, combined with the existing SATs and the characteristics of HEI campuses in this research area, the two-hierarchy SATs have been formulated.

The quick analysis tool

This tool offers a basic and quick analysis of the assessed campuses, aiming at giving a general and primary assessment including all key aspects of sustainability. This tool would be an entry-level sustainable assessment tool that is adaptable to almost all the HEIs in the research area.

The in-depth benchmarking tool

This tool offers an in-depth and comprehensive analysis of the assessed campuses, aimed at proposing benchmarking and complete results to foster campuses' future sustainable plans. This tool would be a more comprehensive tool adaptable to HEIs with basic quantitative data such as annual energy and water consumption.

3.5. Testing and Application of the Tools

This section shows the results of the assessments of the 15 cases by the two-hierarchy SATs. The adaptability and accuracy of the tools were tested. And a comparison of the results with the ASGC was presented.

4. The Two-Hierarchy Tools

The two-hierarchy tools for the HEIs in Beijing–Tianjin–Hebei were developed and presented. First, the conceptual framework and weightings were proposed to establish a comprehensive structure for the tools. Second, the purposes, indicators, weightings, and scoring of each tool were presented.

4.1. The Sustainable Campus Conceptual Framework

A four-level hierarchy of sustainable campus conceptual framework was proposed, with the overall goal of campus sustainability, followed by the three dimensions of (A) built environment, (B) operations, and (C) participation. The third level consists of nine aspects, followed by thirty-three topics in the fourth level (Figure 3).

4.2. The AHP Weighting

Next, the AHP weighting at the aspect level was proposed with the support of the experts' team. The weighting results are as follows (Table 3). The weighting placed significant importance on environmental factors, while also acknowledging the growing significance of social and economic factors.

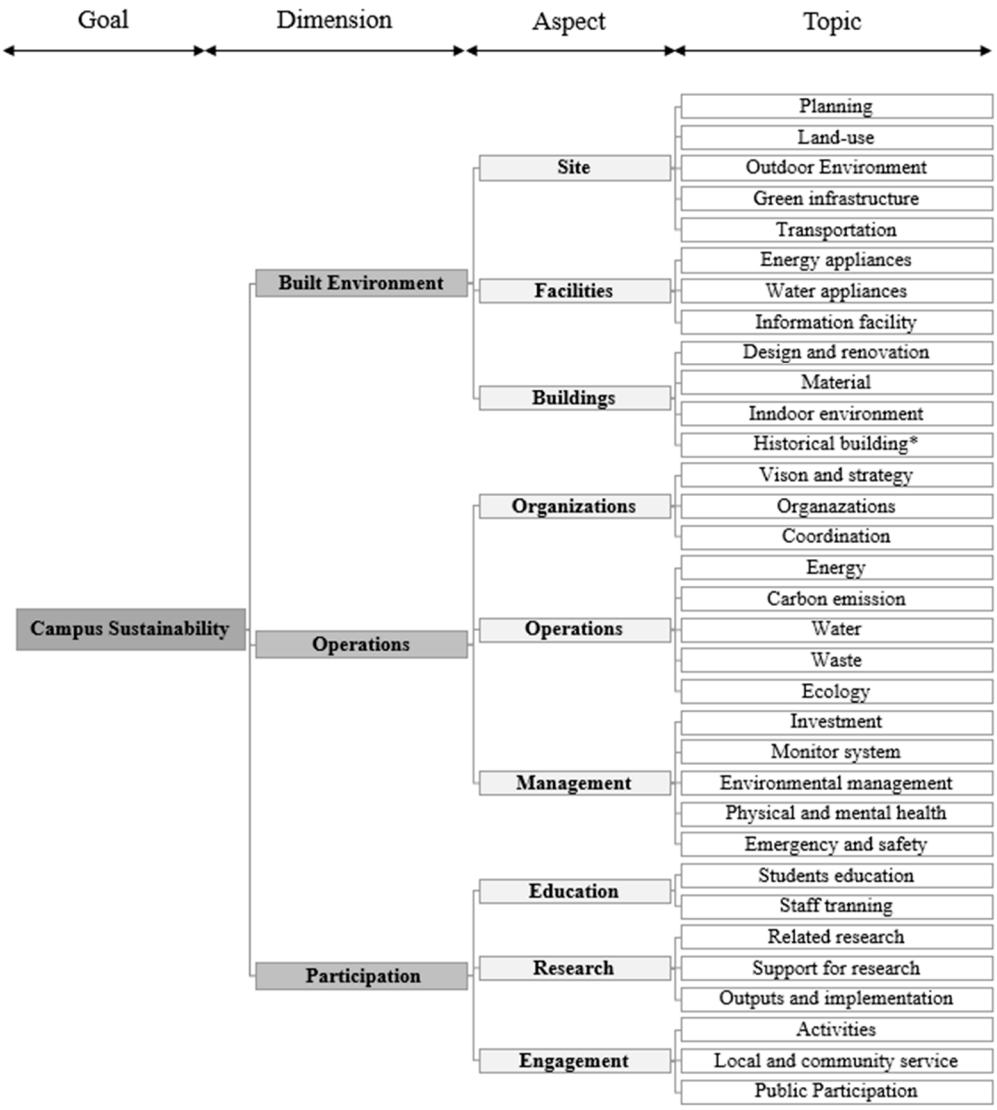

Figure 3. Four level hierarchy for sustainability assessment for the HEIs in Beijing, Tianjin, and Hebei. The * topic is optional for assessment.

Table 3. The weightings for the three-level hierarchy for sustainability assessment of HEIs.

Goal	Dimensions	Weight	Aspects	Weight
Campuses sustainability	Built environment	0.4452	Site	0.1331
			Facilities	0.1501
			Buildings	0.1620
	Operations	0.3537	Organizations	0.0721
			Operations	0.1614
			Management	0.1202
	Participation	0.2009	Education	0.0818
			Research	0.0513
			Engagement	0.0226

4.3. The Sustainable Campus Assessment Tools

The quick analysis and benchmarking tools form a progressive assessment process. Through the application of these tools, HEIs could first have a general and then an in-depth

understanding of their status toward sustainability. The analysis results could help to control the short-, medium-, and long-term sustainable plans, formulating the path and steps for the implementation of the strategy (Figure 4).

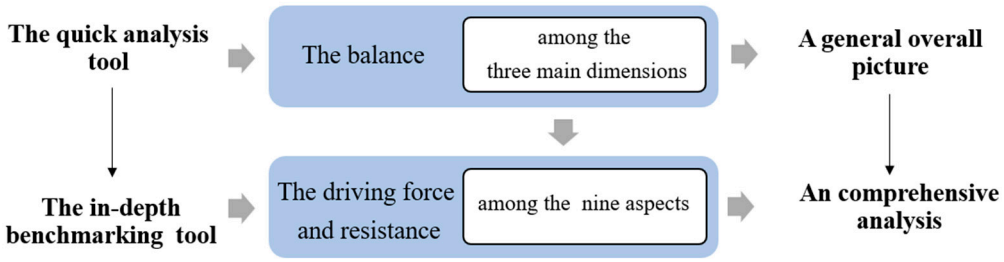

Figure 4. The progressive assessment process of the sustainable campus SATs.

4.3.1. The Quick Analysis Tool

Purpose and stage

The quick analysis tool offered a primary diagnosis of HEIs campuses at almost all the SD stages, to provide a quick, general assessment of the campuses, so as to draw an overall sustainable campus picture of the HEIs.

Indicators and weightings

The tool contains 30 key indicators and is a simplified version of the overall sustainable campus framework. The key indicators are selected based on the main dimensions and aspects of the framework and by considering the accessibility of data to be applied to various developments stage of the campus (Table 4). This tool uses an equal weight of the dimensions, aspects, and indicators.

Table 4. The indicators for the quick analysis tool.

Dimension and Weighting	No.	Indicator	Description (0–4) [1]
Built Environment (A) (0.33)	1	Land area per student	Per student area (m^2/person) = Core Teaching Area area/Total number of students (The value of indicator 1 is calculated by standardizing the value of 15 case samples in this study to a range of 0–4. Sa11 represents the index score; X1 represents the per capita land area; Xmax and Xmin, respectively, represent the maximum value and minimum value range. In the 15 cases of this study, Xmax = 170; Xmin = 11. The calculation method of Sa11 is Sa11 = $\{1 - (X1 - Xmin)/(Xmax - Xmin)\} \times 4$)
	2	Outdoor environment	The overall quality of the outdoor environment (teacher and student/expert assessment)
	3	Green space	The ratio of green space to the core campus area (%)
	4	Rainwater infrastructure	Construction and distribution of rainwater infrastructure
	5	Landscape quality	The quality of the landscape (teacher and student/expert assessment)
	6	Slow traffic	Safety, convenience, and comfort of the slow traffic (teacher and student/expert assessment)
	7	Energy and water efficient appliances	The application of the appliances
	8	Information infrastructure	Wireless network, one card system, and other facilities
	9	Building design	The proportion of green campus building design standard area (one star or above) (%)
	10	Building renovation	The proportion of green campus building renovation standard area (one star or above) (%)

Table 4. *Cont.*

Dimension and Weighting	No.	Indicator	Description (0–4) [1]
Operations (B) (0.33)	11	Vision	The vision and mission
	12	Strategies and plans	Long-term and mid-term plans towards sustainability
	13	Communication	Problem feedback approaches
	14	Energy efficiency	Programs to reduce energy consumption
	15	Water efficiency	Programs to reduce water consumption
	16	Waste treatment	Programs that contribute to recycling and reducing waste
	17	Sustainable budget	The percentage of the university budget for sustainability efforts in a year (%)
	18	Sustainable management	Sustainable campus-related management system
	19	Energy and water monitor	The application of campus energy and a water monitoring system
	20	Smart campus	The application of a smart campus system
Participation (C) (0.33)	21	Curriculum	The ratio of sustainability curriculum to total (%)
	22	Participate in the curriculum	The ratio of green studens participation (%) (survey/expert assessments)
	23	Training	Sustainable training for staff
	24	Related research	Related research
	25	Research budget	Annual sustainability-related research budget
	26	Research application	Practice and application of green research in
	27	Green activity	Organization and participation in green activities
	28	Enterprise cooperation	Enterprises, HEIs, and governments collaborate on sustainable-related projects
	29	Implementation/Service	Enterprise and government cooperation projects. Service to local society

[1] Each indicator is graded using the following range [45]. 0—there is a total lack of information for the indicator. 1—the information presented is of poor performance, equivalent to around 25 per cent of the required full information. 2—the information presented is of regular performance, equivalent of around 50 percent of the full information required by the indicator. 3—the information presented is considered to be of good performance, equivalent of around 75 per cent. 4—The information has an excellent performance.

Scoring

The percentage of the scores in dimensions are calculated (Q_A for the standardized Built Environment score, Q_B for the Operations, and Q_C for the Participation), and finally Q_Z is the average of the three and is used as the final score.

$$Q_Z = (Q_A + Q_B + Q_C)/3 \quad (1)$$

According to the final score, campuses are divided into four categories: Preparatory Green, Light Green, Medium Green, and Deep Green (Table 5). Campuses that score less than 40% ($Q_Z < 0.4$) of the quick analysis will not be recommended for the benchmarking process, to ensure the quality and efficiency of the second process.

Table 5. The four categories of the quick analysis results.

Category	The Value Range of Q_Z	Categories
1	$0 \leq Q_Z < 0.4$	Preparatory Green
2	$0.4 \leq Q_Z < 0.6$	Light Green
3	$0.6 \leq Q_Z < 0.8$	Medium Green
4	$0.8 \leq Q_Z < 1.0$	Deep Green

4.3.2. The In-Depth Benchmarking Tool

Purpose and stage

The benchmarking tool is an integrity assessment based on the sustainable campus framework, considering the scientific nature and accuracy of the data. This tool is applied to the campus with a certain basis for development, offering a systematic and in-depth assessment of HEIs as a reference for future development strategies.

Indicators and weightings

This tool contains 70 indicators (Table 6). These indicators were selected and mortified mainly from the Chinese ASGC, STARS, ASSC, GM, Toolkit, and AISHE (Table A1). Indicators are divided into controlled and scoring ones. The controlled indicators state the basic requirements that HEIs must fulfill. The scoring indicators are recommended to be collected from the official website of the HEIs, from the relevant management and operation departments, and from surveys from the students and staff. The weightings of the indicators were as the results in Section 4.2.

Table 6. The indicators for the in-depth benchmarking tool.

Dimension and Weighting	No	Indicator
Built Environment (BE) (0.45)	1	Overall sustainable development planning
	2 *	Medium and long-term sustainable development planning
	3	Land or spatial use planning
	4	Underground space utilization
	5	Outdoor wind environment
	6 *	Outdoor noise environment
	7	Green Space and heat island effect
	8	Water absorption area
	9 *	Rain water management
	10	Landscape and biodiversity
	11	The surface water quality *
	12	Connection to public transportation
	13	Campus traffic environment
	14	Accessibility of facilities
	15 *	Energy efficiency facility
	16	Water conservation facility
	17	Information-based campus
	18	Green building certification
	19	Building shape coefficient
	20	Building materials
	21 *	Acoustic environment quality
	22 *	Indoor Air Quality
	23	Light environment
	24	Thermal comfort
	25	Historical buildings
Operations (OP) (0.35)	26	Strategy and plan
	27 *	Organizations
	28	Staff and expertise
	29	Enrollment of the stakeholders

Table 6. *Cont.*

Dimension and Weighting	No	Indicator
	30	Report and assessment
	31	Feedback
	32	Energy consumption reduction rate
	33	Renewable energy utilization
	34	Waste heat utilization
	35	Carbon emission
	36	Water consumption reduction rate
	37	Rainwater collection and reuse
	38	The proportion of recycled water
	39	Weight of waste per capita
	40	Waste reduction measures
	41 *	Hazardous waste treatment
	42	Ecological and landscape
	43	Pesticides
	44	Investment and budget
	45	Economical strategies
	46	Green purchase
	47	Ethnically and local investment
	48	Energy monitor system
	49	Smart campus tools
	50	Asset and facility
	51	Principles and rules
	52	Physical and mental health
	53	Healthy circumstances
	54	Prevention of infectious diseases
	55	Emergency and safety measures
Participation (PA) (0.20)	56 *	Medium and long-term education plan
	57	Curriculum
	58	Students enrolled in the curriculum
	59	Supports for curriculum
	60	Campus as a living lab
	61	Training
	62	Research integrating sustainability
	63	Supports for sustainable research
	64	Implementation and commercialization
	65	Green activity
	66	Students' engagement in sustainable operations
	67	Partnerships
	68	Volunteerism/disaster prevention and post-disaster education
	69	Public policy participation
	70	Information disclosure

The * indicators are the controlled ones.

Scoring

The percentage of the score in dimensions and aspects are calculated to make comparisons (MR for scores at the aspect level, MBE for standardized built environment score, MOP for Operations, and MPA for Participation), and finally Md is the sum of the scores.

$$Md = MBE \times 0.45 + MOP \times 0.35 + MPA \times 0.2 \quad (2)$$

The assessment results are divided into four categories, and the number of driving aspects is analyzed (Table 7). The Ma score of less than 40% is the resistance aspects, while the Ma score is greater than 80% is the driving aspects.

Table 7. The four categories of the benchmarking results.

Benchingmarking	Requirement at Overall Level (Md)	Minimum Proportion Requirement for each Aspect-Score (Ma) (Nine Aspects) *
Starter	40% ≤ Md < 50%	None
Mover	50% ≤ Md < 60%	The number of aspects below 40% does not exceed 3
Runner	60% ≤ Md < 80%	The number of aspects below 40% does not exceed 2
Innovator	80% ≤ Md < 100%	The number of aspects below 40% does not exceed 1

* If the total score is satisfied but the sub-score cannot be satisfied, the level will be lowered.

5. Result

The two-hierarchy tools were used to analyze 15 cases of Higher Education Institutions (HEIs) in the Beijing–Tianjin–Hebei region. The scoring results of the cases were presented and compared to evaluate the difference in applicability and scoring results of the tools with the current Chinese green campuses evaluation standard (ASGC).

5.1. Results of the Assessemnts

5.1.1. Results of Quick Analysis

In the quick assessment process, according to the average Q_Z score of each case, the assessment results of the above cases in detail are shown in Table A2. Of the fifteen cases selected in this study, four are Preparatory Green; five are Light Green; five are Medium Green; one is Deep Green (Table 8, Figure 5).

According to the diagnosis results, the four cases of 9TJCM, 13LTU1, 11HSU1, and 12CUGGW are at the Preparatory Green stage ($Q_Z < 0.4$), and the implementation measures and accessible information of a green campus still need to be improved. These cases were in the very initial level of SD and have a relatively obvious gap with other cases and were not recommended for benchmarking. The 11 cases above the Preparatory Green level can be further assessed.

By enrolling in the quick assessment, these cases were generally provided the necessary guidance for its green campus goals to gradually form the preliminary plans so as to enter the track of SD.

Table 8. The result of the 15 cases in category of the quick analysis tool.

Assessment Category	Cases
Preparatory Green ($0 < Q_Z < 0.4$)	9TJCM, 13LTU1, 11HSU1, 12CUGGW
Light Green ($0.4 \leq Q_Z < 0.6$)	4CUMT, 6HEBUT, 10TJCM, 5MUC, 8TFSU
Medium Green ($0.6 \leq Q_Z < 0.8$)	15NKU2, 14TJU2, 7BUA, 3TJU, 2NKU
Deep Green ($0.8 \leq Q_Z < 1.0$)	1THU

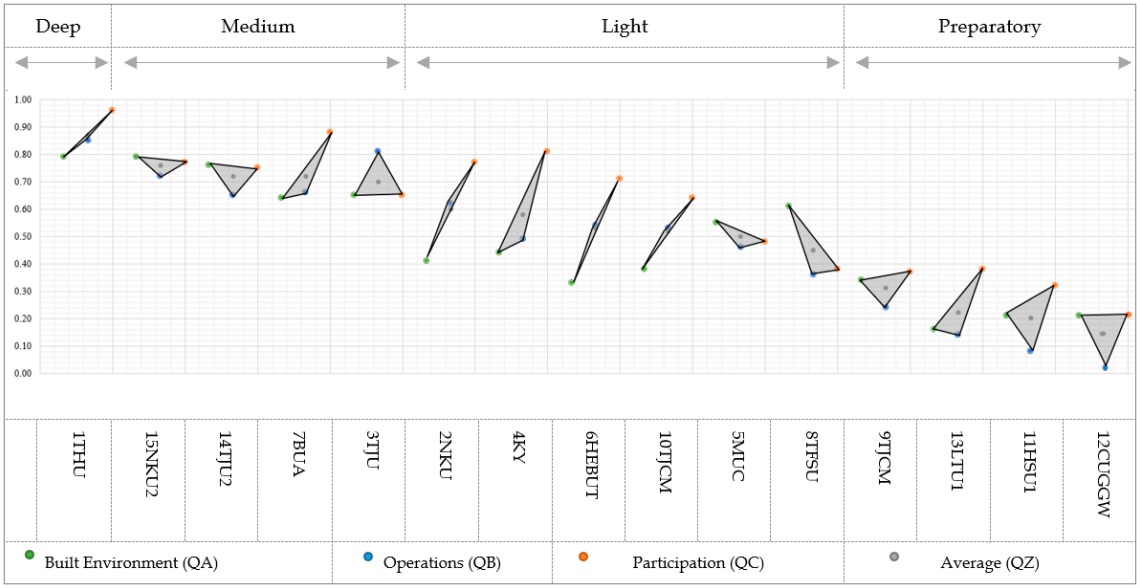

Figure 5. The graphic quick assessment results of the 15 cases.

5.1.2. Results of Benchmarking

Based on the quick assessment, this section further assessed the 11 cases above the Preparatory Green level, analyzed the multi-source data of the campus cases in depth, and simulated, calculated, and described the benchmarking process and results in detail (Table A3).

In the in-depth benchmarking step, the eleven cases are divided into three categories. Four cases were the Movers; five cases were the Runners; two cases were the Innovators; and no case is at the initial level of the Starter (Table 9).

Table 9. The result of the 11 cases in category of the benchmarking tool with the number of the driving aspects (D) and resistance aspects (R).

Benchmarking	Types	Cases
Mover (50% ≤ Md < 60%)	Driver and Resitance	5MUC (D = 1, P = 1)
	Single driver	10TJCM, 8TFSU
	Mutiple drivers	6HEBUT (D = 3)
Runner (60% ≤ Md < 80%)	Single driver	7BUA
	Double drivers	15NKU2, 4KY
	Mutiple drivers	2NKU (D = 3), 3TJU (D = 3)
Innovator (80% ≤ Md < 100%)	Mutiple drivers	1THU (D = 8), 14TJU2 (D = 5)

The Ma score of less than 40% is the resistance aspects, while the Ma score is greater than 80% is the driving aspects.

The Movers, such as 6HEBUT and 10TJCM (50% ≤ Md < 60%, with no more than three aspects scoring less than 40%), have already made some progress in the three main dimensions of green campus and have even made deeper progress in some aspects. However, the foundation of green campus construction is relatively weak or limited by financial resources, lack of organizational experience, etc. The overall scale and depth of construction still need to be improved.

The Runners, such as 15NKU2 and 4KY (60% ≤ Md < 80%, with no more than two aspects less than 40%), have made good progress in each major dimension and achieved obvious results in some aspects; the comprehensiveness of sustainable campus construction can still be improved. The campuses have laid the SD foundations in all dimensions for

current and future continuous improvement. The Innovators, such as 1THU and 14TJU2 (60% ≤ Md < 80%, with no aspect score lower than 40%), with multiple drivers, have achieved a high level of progress in most aspects. The two cases showed a relatively balanced state in the nine aspects, but the scores in the building aspects were relatively in the middle (the proportion of scores did not reach 80%).

Then, the 11 cases were compared in the three dimensions and in the overall benchmarking.

From the Built Environment dimension, the score of 11 cases in the three aspects showed a fluctuating trend with the increase of the overall benchmarking category (Figure 6). The aspect of Site (BE1) fluctuates greatly (40–85%) with the increase of the benchmarking category and is followed by the aspect of Buildings (BE3) with the range of 40–70%. The scores in the aspect of Facilities (BE2) were relatively high with little fluctuation between 80 and 100%.

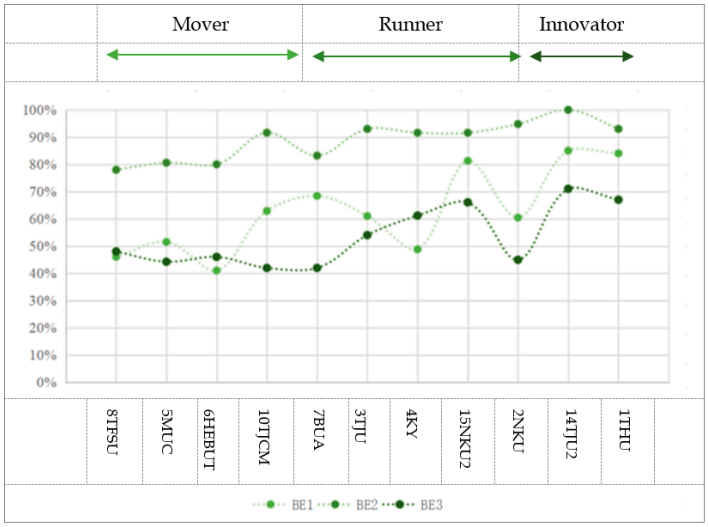

Figure 6. The scores of the Built Environment dimension of the 11 cases in the order of the total score from lowest to highest.

From the Operations dimension, the aspect of Operations (OM2) fluctuates greatly (30–90%) with the increase of the benchmarking category, followed by the aspect of Management (OM3) and Organizations (OM1) with the range of 60–90% (Figure 7).

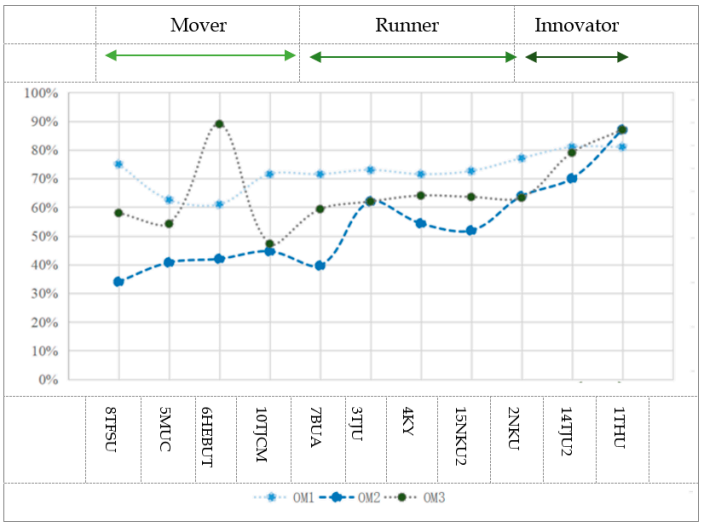

Figure 7. The scores of the Operations dimension of the 11 cases in the order of the total score from lowest to highest.

From the Participation dimension, the aspect of Research (EN2) fluctuates greatly (30–90%) with the increase of the benchmarking category, followed by the aspect of Engagement (EN2) with the range of 40–80%. The scores in the aspect of Education (EN1) were relatively high with relatively little fluctuation between 60 and 90% (Figure 8).

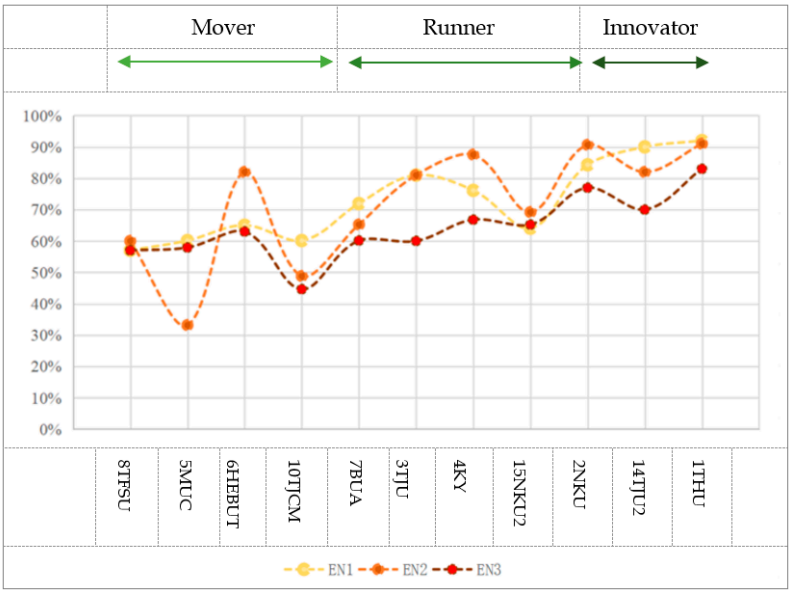

Figure 8. The scores of the Participation dimension of the 11 cases in the order of the total score from lowest to highest.

Combined with the current situation of the cases, it can be seen that the aspects such as Site (BE1) and Facilities (BE2) included the key factors of energy efficiency campuses that have been funded for renovation. Some energy efficiency demonstration campuses had relatively good performance in these aspects. Some aspects such as Organizations (OM1) and Education (EN1) contain the basic indicators in the initial stages of SD and have been adopted by most campuses. Some aspects such as Buildings (BE3) and Engagement (EN2) include indicators that are time or resources consuming and were relatively challenging to score at a high level.

It can be seen that when the development of sustainable campuses reaches a certain level, the promotion of a single dimension and aspects will face the bottleneck, and multi-dimensional coordination and complementarity are needed to jointly promote the improvement of the comprehensive level of the sustainable campus. And it needs continuous SD strategy and plans to reach the higher level, but it is still challenging for most campuses to integrate SD in campuses' strategic planning to strive for optimum added value in the long term [46].

5.2. Comparison of the Assessments Result

5.2.1. The Quick Analysis Tool (QAT) and ASGC

First, the 15 cases were analyzed for the data accessibility of the QAT and ASGC indicators, with the four categories [47] of Formal, Not Formal, Some Evidence, and No Evidence. The analysis showed that the three cases of 9TJCM, 13LTU1, and 12CUGGW have over 60%, and 11HSU1 has around the 60% of the ASGC indicators with No Evidence. Because there is no relevant evidence or accessible evident data, it is not recommended that these four cases use the ASGC for assessment (Table 10).

After comparing the cases, we found that the QAT indicators were able to find evidence for all 15 cases, indicating strong overall applicability. However, the ASGC indicators showed that there were four cases that lack evidence. It is important to note that insufficient information may affect the accuracy of the results of ASGC.

Table 10. The ratio of No Evidence data of the 15 cases of the quick analysis tool (QAT) and ASGC.

The Ratio of No Evidence (NE)	Cases														
	1THU	2NKU	3TJU	4CUMT	5MUC	6HEBUT	7BUA	8TFSU	9TJCM	10TJCM	11HSU1	12CUGGW	13LTU1	14TJU2	15NKU2
QAT	0%	0%	0%	5%	5%	5%	3%	6%	5%	3%	6%	6%	10%	0%	8%
ASGC	12%	9%	12%	26%	27%	21%	13%	38%	62%	25%	60%	63%	67%	5%	20%

5.2.2. The In-Depth Benchmarking Tool (IBT) and ASGC

To better analyze the characteristics of the two-hierarchal tools, the assessment results of the benchmarking tool of the HEIs cases were compared with the ASGC (Table 11). Besides the four cases, five cases at different SD levels were assessed and normalized to percentages to compare their results. It can be seen that the assessment results of the proposed benchmarking tool and ASGC were as follows (Figure 9).

Table 11. The results of the five cases of the in-depth benchmarking tool (IBT) and ASGC.

Assessment Category (M)	The Bencnmarking Tool	The ASGC
$M \geq 80\%$	1THU (84%) 14TJU2 (80%)	1THU (85%) 14TJU2 (87%)
$60\% \leq M < 80\%$	3TJU (66%)	3TJU (76%)
$40\% \leq M < 60\%$	6HEBUT (55%) 8TFSU (54%)	6HEBUT (56%) 8TFSU (58%)

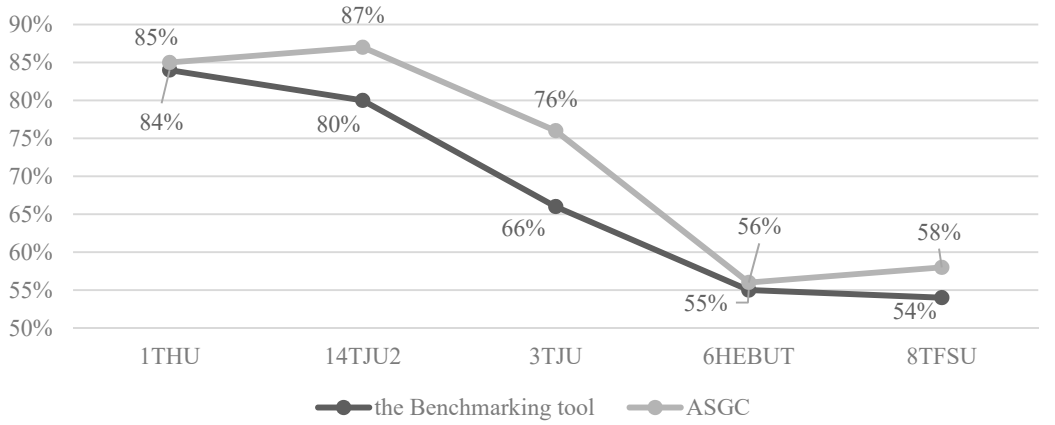

Figure 9. The comparison of the results of the five cases of the benchmarking tool and ASGC.

- Both tools have categorized the five cases into three levels. And the results of the IBT are in some cases relatively low compared to ASGC.
- In the case with the highest score, both tools showed consistent results and identified the best case (1THU). This case had high scores in all dimensions, indicating strong comprehensiveness in sustainability. In the cases of 14TJU2 and 3TJU, there was a gap between the BKT and ASGC, with the BKT score being about 10% lower than ASGC. This suggests that the BKT score has higher comprehensive requirements, and only cases with good performance in the environmental, social, and economic dimensions will have a higher score in the BKT. For the last two cases (6HEBUT and 8TFSU), the difference between the two tools was not significant, indicating that the comparison

was mostly focused on the score of the environment, with other aspects not being dominant and therefore not contributing to a large gap in scores.
- The benchmarking tool showed a more balanced emphasis on the core dimensions of sustainability and paid more attention to the state of campus operations. This was the main reason for the difference in the results.

Compared to the existing SATs, THSus showed its distinguished character in leading HEI cases toward more comprehensive sustainability in the flowing aspects. First, it showed better overall applicability to the HEIs in Beijing, Tianjin, and Hebei. and cases with insufficient data can be assessed for primary diagnosis by the quick analysis tool. All 15 cases were able to use the quick analysis tool for assessment rather, and at least four cases were not able to use ASGC (with less than 60% of the indicators with some evidence for assessment). Second, it showed the pursuit of the core of sustainability by a more balanced weighting on environmental operations compared to ASGC and enrolled both important and applicable indicators in the benchmarking tool. Consequently, the 11 cases obtained scores that were 1% to 10% lower than those of ASGC. Additionally, it is evident that the highest-scoring cases in both tools were influenced by multiple contributing drivers.

6. Discussion

In the context of Chinese campuses, the international SATs and the Chinese ASGC may not be entirely suitable and require modifications to fit the local practices. This is because, on the one hand, the amount and accuracy of campus data are insufficient to participate in the assessment in some cases. On the other hand, some SATs, especially the ASGC, prioritize the assessment of the environment. Therefore, for the Beijing–Tianjin–Hebei campuses, it is necessary to develop an SAT that is more adaptable and emphasizes the comprehensive core of a sustainable campus.

The conceptual framework was inspired by the review of the 15 SATs [11] and summarized as five dimensions of governance, operations, education, research, and engagement and considers the core of campus sustainability and stakeholder engagement in the local HEIs to be reorganized as three dimensions of the Built Environment, Operations, and Participation. The environmental issues were addressed, and other important issues were added, as have been explored in other Chinese regional SATs [20,22].

Comparisons have been made regarding the weightings of SATs, and there have been calls for a decrease in the environmental operations of the Chinese SAT. The weighting of the benchmarking tool highlights the importance of environmental performance, which consists of 36 indicators and carries an overall weight of 61%, which showed around a 10% decrease compared to the current Chinese standard ASGC. This weighting approach could contribute to a more comprehensive and balanced assessment.

Considering the different SD levels and comprehensive goals of sustainable campuses, a two-hierarchy tool would be one of the solutions. In comparison to ASGC, the quick analysis tool can be utilized in these 15 cases, and cases with insufficient information are filtered out by scoring (less than 40%) before further assessment. The QAT can efficiently identify campus problems and improve the efficiency of in-depth assessment. This tool was inspired by AISHE [39] and GM [37]. The assessment results of benchmarking tool showed a difference between it and ASGC. Campuses that prioritize the environment over social and economic aspects experienced a comprehensive score drop of nearly 10% compared to ASGC. The assessment results also indicated that campuses that scored highest in both the QAT and ASGC were influenced by multiple drivers. The two-hierarchy SATs have some limitations that could be explored in future research. To begin with, this research takes the 15 HEIs cases in the Beijing–Tianjin–Hebei as an example, and more cases could be included in future research to fully analyze the characteristics of the Chinese HEIs. Second, although the framework and indicators were proposed based on the characteristics of the HEIs, it still needs more empirical case studies to make indicators better reflect the capacity to effect change.

Compared to the number and diversity of Chinese HEI campuses, future research should further explore the common and unique characteristics of the current situation and SD strategies of the HEIs. With the development of digital and smart campuses, it would need more accessible data to better characterize the campuses. And it would be of practical importance to conduct an annually continuous assessment to track the SD of HEIs and analyze the SD strategies and their payoff for campuses' decision-making.

7. Conclusions

Chinese HEIs are still in their early stage of sustainability and in need of regional sustainable assessment tools (SATs) that address the international SDGs and are more adaptable to local contexts. Based on the analysis of existing SATs and characteristics of the 15 HEIs cases, with the engagement of a 34-person expert team, this research proposed the sustainable assessment framework and the more adaptable two-hierarchy SATs for the HEIs in Beijing–Tianjin–Hebei.

The proposed two-hierarchy SATs included a quick and in-depth assessment tool that could be adapted to HEIs cases at different stages of sustainable development. The quick analysis tool offers an overall picture of the campuses. The in-depth benchmarking tool offers a comprehensive analysis that leads the SD. Compared to the ASGC, the two-hierarchy SATs showed better applicability and efficiency to the HEIs in the researched area and address the comprehensive core of sustainable campuses.

The benchmarking assessment results showed that a single driver could be leading SD in the early stage. However, to achieve a higher level of sustainability, it is necessary for multiple drivers to work together. For the cases that could play the active leading roles, their overall sustainable development is relatively balanced, fully exploiting the advantages of the campuses in a state of multiple cooperation and mutual promotion.

This two-hierarchy SAT offered a solution for regional campuses in different stages of SD to adopt sustainable assessment and also provided key indicators for campuses to be on the track of SD, which shed light on strategic planning for future development.

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Appendix A

Table A1. The 15 SATs reviewed and inspired this study.

No.	SATs	Abbreviation	Context	Selected and/or Modified Indicators from the SATs (Y for YES.)
1.	Assessment Instrument for Sustainability in Higher Education	AISHE	Global	Y
2.	Adaptable Model for Assessing Sustainability in Higher Education	AMAS	Regional (Chile)	
3.	Assessment System for Sustainable Campus	ASSC	Regional (Japan)	Y
4.	Campus Sustainability Assessment Framework Core	CSAF Core	Regional (Canada)	
5.	Graphical Assessment of Sustainability in University	CASU	Global	
6.	GreenMetric World University Rankings	GM	Global	Y
7.	People & Planet Green League	P&P	Regional (UK)	
8.	Pacific Sustainability Index	PSI	Regional (US)	
9.	Sustainability Assessment Questionnaire	SAQ	Global	
10.	Sustainability Tracking, Assessment and Rating System for Colleges and Universities	STARS	Global	Y
11.	Sustainable University Model	SUM	Global	
12.	Sustainability in Higher Education Institutions	SusHEI	Regional (Portugal)	
13.	Greening Universities Toolkit	Toolkit	Global	Y
14.	Unit-based Sustainability Assessment Tool	USAT	Regional (Africa)	
15.	Assessment Standard for Green Campus	ASGC	Regional (China)	Y

Table A2. The results of the 15 cases from the quick analysis tool.

Score	Cases														
	1THU	2NKUU	3TJUU	4CUMT	5MUC	6HEBUT	7BUA	8TFSU	9TJCM	10TJCM	11HSU1	12CUGGW	13LTU1	14TJU2	15NKU2
Built Environment (Q_A)	0.79	0.41	0.65	0.44	0.55	0.33	0.64	0.61	0.34	0.38	0.21	0.21	0.16	0.76	0.79
Operations ($Q_{B)}$	0.85	0.62	0.81	0.49	0.46	0.54	0.66	0.36	0.24	0.53	0.08	0.00	0.14	0.65	0.72
Participation (Q_C)	0.96	0.77	0.65	0.81	0.48	0.71	0.88	0.38	0.37	0.64	0.32	0.21	0.38	0.75	0.77
Average (Q_Z)	0.87	0.60	0.70	0.58	0.50	0.53	0.72	0.45	0.31	0.52	0.20	0.14	0.22	0.72	0.76

Table A3. The results of 11 cases from the benchmarking tool.

Scores	Cases										
	1THU	14TJU2	2NKU	15NKU2	4KY	3TJU	7BUA	10TJCM	6HEBUT	5MUC	8TFSU
M_{BE1}	84%	85%	60%	81%	49%	61%	68%	63%	41%	52%	46%
M_{BE2}	93%	100%	95%	92%	92%	93%	83%	92%	80%	81%	78%
M_{BE3}	67%	71%	45%	66%	61%	54%	42%	42%	46%	44%	48%
M_{OM1}	81%	81%	77%	73%	72%	73%	72%	72%	61%	63%	75%
M_{OM2}	87%	70%	64%	52%	54%	62%	40%	45%	42%	41%	34%
M_{OM3}	87%	79%	63%	64%	64%	62%	59%	47%	89%	54%	58%
M_{EN1}	92%	90%	84%	64%	76%	81%	72%	60%	65%	60%	57%
M_{EN2}	91%	82%	91%	69%	88%	81%	65%	49%	82%	33%	60%
M_{EN2}	83%	70%	77%	65%	67%	60%	60%	45%	63%	58%	57%
Md	84%	80%	70%	69%	67%	66%	60%	57%	55%	54%	54%

References

1. Wang, C.; Geng, L.; Rodríguez-Casallas, J.D. How and When Higher Climate Change Risk Perception Promotes Less Climate Change Inaction. *J. Clean. Prod.* **2021**, *321*, 128952. [CrossRef]
2. Dale, A.; Newman, L. Sustainable Development, Education and Literacy. *Int. J. Sustain. High. Educ.* **2005**, *6*, 351–362. [CrossRef]
3. Alam, G.M. Sustainable Education and Sustainability in Education: The Reality in the Era of Internationalisation and Commodification in Education—Is Higher Education Different? *Sustainability* **2023**, *15*, 1315. [CrossRef]
4. UNESCO. *Education for Sustainable Development: A Roadmap*; United Nations Educational, Scientific and Cultural Organization: Paris, France, 2020.
5. Flores-Aguilar, G.; Prat-Grau, M.; Fernández-Gavira, J.; Muñoz-Llerena, A. "I Learned More Because I Became More Involved": Teacher's and Students' Voice on Gamification in Physical Education Teacher Education. *Int. J. Environ. Res. Public Health* **2023**, *20*, 3038. [CrossRef]
6. den Heijer, A.C.; Magdaniel, F.T.J.C. The University Campus as a Knowledge City: Exploring Models and Strategic Choices. *Int. J. Knowl. Based Dev.* **2012**, *3*, 283. [CrossRef]
7. Cottafava, D.; Ascione, G.S.; Corazza, L.; Dhir, A. Sustainable Development Goals Research in Higher Education Institutions: An Interdisciplinarity Assessment through an Entropy-Based Indicator. *J. Bus. Res.* **2022**, *151*, 138–155. [CrossRef]
8. Priyadarshini, P.; Abhilash, P.C. Rethinking of Higher Education Institutions as Complex Adaptive Systems for Enabling Sustainability Governance. *J. Clean. Prod.* **2022**, *359*, 132083. [CrossRef]
9. Mohammadi, Y.; Monavvarifard, F.; Salehi, L.; Movahedi, R.; Karimi, S.; Liobikienė, G. Explaining the Sustainability of Universities through the Contribution of Students' Pro-Environmental Behavior and the Management System. *Sustainability* **2023**, *15*, 1562. [CrossRef]
10. Klein, L.L.; Alves, A.C.; Abreu, M.F.; Feltrin, T.S. Lean Management and Sustainable Practices in Higher Education Institutions of Brazil and Portugal: A Cross Country Perspective. *J. Clean. Prod.* **2022**, *342*, 130868. [CrossRef]
11. Chen, Y.; Liu, G.; Zhuang, T. Evaluating the Comprehensive Benefit of Urban Renewal Projects on the Area Scale: An Integrated Method. *Int. J. Environ. Res. Public Health* **2022**, *20*, 606. [CrossRef]
12. Giovanelli, L.; Rotondo, F.; Ezza, A. Business Models for Integration of Sustainability in Universities: An Explorative Analysis of Italian State Universities. *J. Clean. Prod.* **2021**, *324*, 129227. [CrossRef]
13. Larrán Jorge, M.; Herrera Madueño, J.; Calzado, Y.; Andrades, J. A Proposal for Measuring Sustainability in Universities: A Case Study of Spain. *Int. J. Sustain. High. Educ.* **2016**, *17*, 671–697. [CrossRef]
14. Gómez, F.U.; Sáez-Navarrete, C.; Lioi, S.R.; Marzuca, V.I. Adaptable Model for Assessing Sustainability in Higher Education. *J. Clean. Prod.* **2015**, *107*, 475–485. [CrossRef]
15. Du, Y.; Arkesteijn, M.H.; den Heijer, A.C.; Song, K. Sustainable Assessment Tools for Higher Education Institutions: Guidelines for Developing a Tool for China. *Sustainability* **2020**, *12*, 6501. [CrossRef]
16. Tan, H.; Chen, S.; Shi, Q.; Wang, L. Development of Green Campus in China. *J. Clean. Prod.* **2014**, *64*, 646–653. [CrossRef]
17. MoE Action Plan for Green Campus. Available online: https://www.ndrc.gov.cn/xwdt/ztzl/qgjnxcz/bmjncx/202006/t20200626_1232117.html (accessed on 24 January 2023).
18. Hongbo, L.; Xia, Z.; Yunfeng, L. A Summary of the Research on Green Campus Construction in China. *Tianjin Sci. Technol.* **2017**, *44*, 96–98. [CrossRef]
19. MOHURD. MoE The Construction and Management Guidelines of Energy and Resource Efficient Campus in Colleges and Universities (Trial Implementation). Available online: http://www.moe.gov.cn/jyb_xxgk/moe_1777/moe_1779/201409/t20140917_175035.html (accessed on 24 January 2023).
20. Zhu, B.; Dewancker, B. A Case Study on the Suitability of STARS for Green Campus in China. *Eval. Program Plan.* **2021**, *84*, 101893. [CrossRef]
21. Du, Y.; Zou, Z.; He, Y.; Zhou, Y.; Luo, S. Beyond Blue and Green Spaces: Identifying and Characterizing Restorative Environments on Sichuan Technology and Business University Campus. *Int. J. Environ. Res. Public Health* **2022**, *19*, 13500. [CrossRef]
22. Shuqin, C.; Minyan, L.; Hongwei, T.; Xiaoyu, L.; Jian, G. Assessing Sustainability on Chinese University Campuses: Development of a Campus Sustainability Evaluation System and Its Application with a Case Study. *J. Build. Eng.* **2019**, *24*, 100747. [CrossRef]
23. *CSUS-GBC 04-2013*; Evaluation Standards for Green Campus. China Green Building Council of Chinese Society for Urban Studies: Beijing, China, 2013.
24. *GB/T51356-2019*; Assessment Standard for Green Campus. Ministry of Housing and Urban-Rural Development of the PRC: Beijing, China, 2019.
25. MHURD Announcement of the Ministry of Housing and Urban-Rural Development on the Issuance of the National Standard "Assessment Standard for Green Campus". Available online: https://www.mohurd.gov.cn/gongkai/fdzdgknr/tzgg/201909/20190911_241758.html (accessed on 24 January 2023).
26. MoE Bulletin of National Education Statistics. 2022. Available online: http://www.moe.gov.cn/jyb_sjzl/moe_560/2021/ (accessed on 24 January 2023).
27. China Education Daily Taking Root in China, Forging Ahead and Strengthening the Country: 70 Years of Higher Education Reform and Development in New China. Available online: https://www.chsi.com.cn/jyzx/201909/20190927/1829961780.html (accessed on 24 January 2023).
28. den Heijer, A.C.; Curvelo Magdaniel, F.T.J. Campus–City Relations: Past, Present, and Future. *Geogr. Univ.* **2018**, *12*, 439–459.

29. Chen, J. *University Campus Beijing*; Tsinghua University Press: Beijing, China, 2014.
30. Lindsay Cole, B. Assessing Sustainability on Canadian University Campuses: Development of a Campus Sustainability Assessment Framework. Master's Thesis, Royal Roads University, Victoria, BC, Canada, 2003.
31. Shi, H.; Lai, E. An Alternative University Sustainability Rating Framework with a Structured Criteria Tree. *J. Clean. Prod.* **2013**, *61*, 59–69. [CrossRef]
32. Gutu, I.; Agheorghiesei, D.T.; Tugui, A. Assessment of a Workforce Sustainability Tool through Leadership and Digitalization. *Int. J. Environ. Res. Public Health* **2023**, *20*, 1360. [CrossRef] [PubMed]
33. Dawodu, A.; Dai, H.; Zou, T.; Zhou, H.; Lian, W.; Oladejo, J.; Osebor, F. Campus Sustainability Research: Indicators and Dimensions to Consider for the Design and Assessment of a Sustainable Campus. *Heliyon* **2022**, *8*, e11864. [CrossRef] [PubMed]
34. Alshuwaikhat, H.M.; Abubakar, I. An Integrated Approach to Achieving Campus Sustainability: Assessment of the Current Campus Environmental Management Practices. *J. Clean. Prod.* **2008**, *16*, 1777–1785. [CrossRef]
35. AASHE STARS Technical Manual 2.2. Available online: https://stars.aashe.org/resources-support/technical-manual/ (accessed on 1 July 2023).
36. Sustainable Campus Management Office of Hokkaido, University Assessment System for Sustainable Campus 2013. Available online: https://www.osc.hokudai.ac.jp/en/action/assc. (accessed on 1 July 2023).
37. University of Indonesia, UI GreenMetric Guideline 2019 English 1.2. Available online: https://greenmetric.ui.ac.id/about/methodology. (accessed on 1 July 2023).
38. UN Environment Programme Greening Universities Toolkit. Available online: https://www.unenvironment.org/resources/toolkits (accessed on 24 January 2021).
39. Roorda, N.; Waara, S.; Urbano Fra Paleo, S. AISHE 2.0 Manual Assessment Instrument for Sustainability in Higher Education Edition 2.0 Second Draft AISHE 2.0. Available online: https://www.eauc.org.uk/theplatform/aishe (accessed on 1 July 2023).
40. Fadzil, Z.F.; Hashim, H.S.; Che-Ani, A.; Aziz, S. Developing a Campus Sustainability Assessment Framework for the National University of Malaysia. *Int. J. Environ. Ecol. Eng.* **2012**, *6*, 333–334.
41. Waheed, B.; Khan, F.I.; Veitch, B.; Hawboldt, K. Uncertainty-Based Quantitative Assessment of Sustainability for Higher Education Institutions. *J. Clean. Prod.* **2011**, *19*, 720–732. [CrossRef]
42. Alghamdi, N.; den Heijer, A.; de Jonge, H. Assessment Tools' Indicators for Sustainability in Universities: An Analytical Overview. *Int. J. Sustain. High. Educ.* **2017**, *18*, 84–115. [CrossRef]
43. Xiao, O. Simulation and Optimal Regulation of Urban Land Use Expansion in Changzhutan Urban Agglomeration Based on Symbiosis Concept. Ph.D. Thesis, Hunan Normal University, Changsha, China, 2020.
44. Du, Y.; Zheng, Y.; Wu, G.; Tang, Y. Decision-Making Method of Heavy-Duty Machine Tool Remanufacturing Based on AHP-Entropy Weight and Extension Theory. *J. Clean. Prod.* **2020**, *252*, 119607. [CrossRef]
45. Lozano, R. The State of Sustainability Reporting in Universities. *Int. J. Sustain. High. Educ.* **2011**, *12*, 67–78. [CrossRef]
46. Arkesteijn, M.H. *Corporate Real Estate Alignment: A Preference-Based Design and Decision Approach*; Delft University of Technology: Delft, The Netherlands, 2019.
47. Parvez, N.; Agrawal, A. Assessment of Sustainable Development in Technical Higher Education Institutes of India. *J. Clean. Prod.* **2019**, *214*, 975–994. [CrossRef]

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Approaches and Reforms in Undergraduate Education for Integration of Major and General Education: A Comparative Study among Teaching, Teaching—Research, and Research Universities in China

Changfeng Xue [1,*], Tianping Yang [1] and Muhammad Umair [2,*]

[1] College of Teacher Education, Zhejiang Normal University, Jinhua 321004, China
[2] College of Life Science, Zhejiang Normal University, Jinhua 321004, China
* Correspondence: changfeng@zjnu.edu.cn (C.X.); umairm@zjnu.edu.cn (M.U.)

Abstract: With the major education model as the dominant model, general education is squeezed in quality and quantity, and implementing the concept of general education is challenging. There are several problems in undergraduate education with "strong majors and weak general education" that need to be addressed in order to integrate major education with general education. Therefore, we selected three levels of universities: nine first-class research universities, seven key provincial teaching–research universities, and seven teaching universities from China. One-way ANOVA, principal component analysis (PCA), and cluster analysis were used to analyze the differences in three kinds of universities based on the total undergrad credits and "big category" majors. One-way ANOVA results showed that "total undergrad credits" and "big category" majors are significantly different between research universities, teaching–research universities, and teaching universities, but there are no significant differences in minor course credits, general course credits, disciplinary and major basic course credits, and elective course credits. Based on cluster analysis, the first cluster G1 showed that all the research universities had similarities in the total undergrad credits, minor course credits, general course credits, disciplinary and major basic course credits, elective course credits, and "big category" majors. PCA results confirmed that research universities are significantly separated from teaching universities and teaching–research universities at the PC1 axis, which has a higher number of "big category" majors. There are three key issues with strong majors and weak general education: (1) the difficulties in popularizing the progressive minor training model; (2) the low percentage of elective courses, general elective courses, and individualized courses; and (3) major transfer system restrictions. Based on their own student characteristics and school resources, teaching universities, research universities, and teaching–research universities are encouraged to enhance the cultivation of students' compound knowledge and skills at the three levels of micro-major, double degree (minor degree), and minor-major (double majors or second majors), respectively. The universities should adhere to the diversified combination of general and major education, the integration-oriented undergraduate education, the reform concept of reducing burden and improving quality, appropriately increase students' freedom of choice in undergraduate instructional management for an effective combination of "general education and major education", and then bring the undergraduate education to a characteristic and high level.

Keywords: general education; major education; major–minor; undergraduate courses; talent training model; major transfer system

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1. Introduction

China's higher education system was primarily created in the 1950s and 1960s in imitation of the former USSR's higher educational system [1]. China's higher education did not undergo significant reforms or modifications until the late 1990s. With the development of

China's higher education, academics, policymakers, and the general public have been more interested in the distribution of higher education opportunities and resources [2]. To meet the demands of rapid economic and social growth, China began to significantly expand its higher education system. With a gross enrollment rate of 51.6% in 2019, China entered the next stage of popularization [3]. Nowadays, China has the largest higher education system worldwide in terms of student enrollment [4]. According to Wu Shulian, Chinese institutes are classified into research universities, teaching–research universities, and teaching universities [5]. The universities in China take on the majority of the responsibility of educating the huge enrollment [6].Teaching universities have the highest percentage (86.3%) of bachelor's degree programs compared to other universities. As the rank of universities goes higher, the percentage of bachelor's degree programs becomes lower [7]. Compared with the global trend, the advantages of Chinese university graduates' basic abilities are reflected in language, leadership, and subject knowledge, while their weaknesses are reflected in skills, creativity, and negotiation. Obviously, university education must give equal attention to the basic knowledge and "soft skills" of college students [8].

The major-based educational system in Chinese universities has continued to profoundly affect higher education practices; it is anchored in the mindset of administrators, teachers, guardians, and learners [9]. "Major" is a notion with significant local characteristics that serves as the foundation of China's university education system [10]. Major systems are notably controlled and conservative. A major is an organizational unit with strong and substantial implications that not only reflects a set of courses based on the divisions of fields and professions. A university's numerous majors not only have reasonably defined limits in terms of academic subjects and knowledge domains, but they are also organized into strong organizations through significant budget allocation. The government has constructed a leading major management structure, and students, professors, and instructional facilities are assigned depending on majors. The organization and administration of universities are directly determined by "majors" [10]. Undergraduate major education in our country is actually compatible with the nature of postgraduate education, so it has a strong substitution and inhibition effect on the differentiated development of postgraduate education. Postgraduate education has the potential to accelerate the gradient upgrade of human capital [11]. In the past, the "historical dislocation" caused by the underdevelopment of postgraduate education should have been changed, resulting in undergraduate education directly replacing postgraduate education to cultivate "specialized talents". From the perspective of the entire university education level, China's university education presents the characteristics of "repeatedly deepening specialization".

General education, as a concept and curriculum in China's major education system, has always been marginalized, lacking cultural traditions, resources, ownership, and institutional support [12]. The general education in the universities of China has many issues such as a complex model, a disordered structure, and poor quality in the course content and structure, the randomness of the general education curriculum system, the limited credits of general elective courses, and the uneven depth [9,10]. The integration of general and major education is weak in both form and content. Due to the prior selection of majors and the large proportion of major course credits, it squeezes the space of general course credits and makes general education weaker, which does not play the role of shaping personalities or cultivating rationality and thinking [13].

The talent training model is shaped for a narrow major field from the beginning of the undergraduate degree. With the increase in academic qualifications, the talent training model becomes more and more narrow. The 13th Five-Year Plan for the Development of National Education had proposed to "explore the talent training mode combining general education with major education". The Industrial Internet, Industry 4.0, and Made in China 2025 have become cross-border production and manufacturing systems, and the requirements for talents must also be cross-border [14]. The combination of major and general education is a "new form" of the pursuit or reform of undergraduate education. There are three main reasons for the combination of major and general education, i.e., the

lack of "soft skills" in the talent training model, the trend of cross-border connections, and the rapid development of postgraduate education. Therefore, there is an urgent need to clarify and find the existing problems in undergraduate education development and shift from "strong majors and weak general education" to an effective "combination of major and general education". The queries we endeavored to address were:

How significant is the integration of major and general education development at different levels of undergraduate universities in terms of majors, courses, and management?

What problems exist in the "strong majors and weak general education" system?

How can major and general education be effectively integrated?

2. Materials and Methods

2.1. Selection of Universities and Collection of Data

This study selected three levels of universities, namely, 9 first-class research universities, 7 key provincial teaching–research universities in Zhejiang, and 7 teaching universities (Figure 1). The most campuses are found at Zhejiang University (8 campuses), followed by Peking University (6 campuses), Hangzhou Dianzi University (5 campuses), Zhejiang Normal University, Zhejiang Sci-Tech University, Tongji University, Fudan University, and Shaoxing University (4 campuses), and other universities have less than 4 (Figure 2 and Table S1). We collected documents related to undergraduate talent training, such as undergraduate talent training programs, undergraduate teaching quality reports, minor–major management regulations, and student handbooks, that are open to the public on the official websites of 23 universities. This study assumes that there are differences in the combination of major and general education at three levels of universities and analyzes the differences in the talent training mode of the major and general education combination at different levels from six aspects: total undergrad credits, minor course credits, general course credits, major course credits, elective course credits, and "big category" majors.

Figure 1. The location of the 23 selected Universities in China. Codes are given in Table S1.

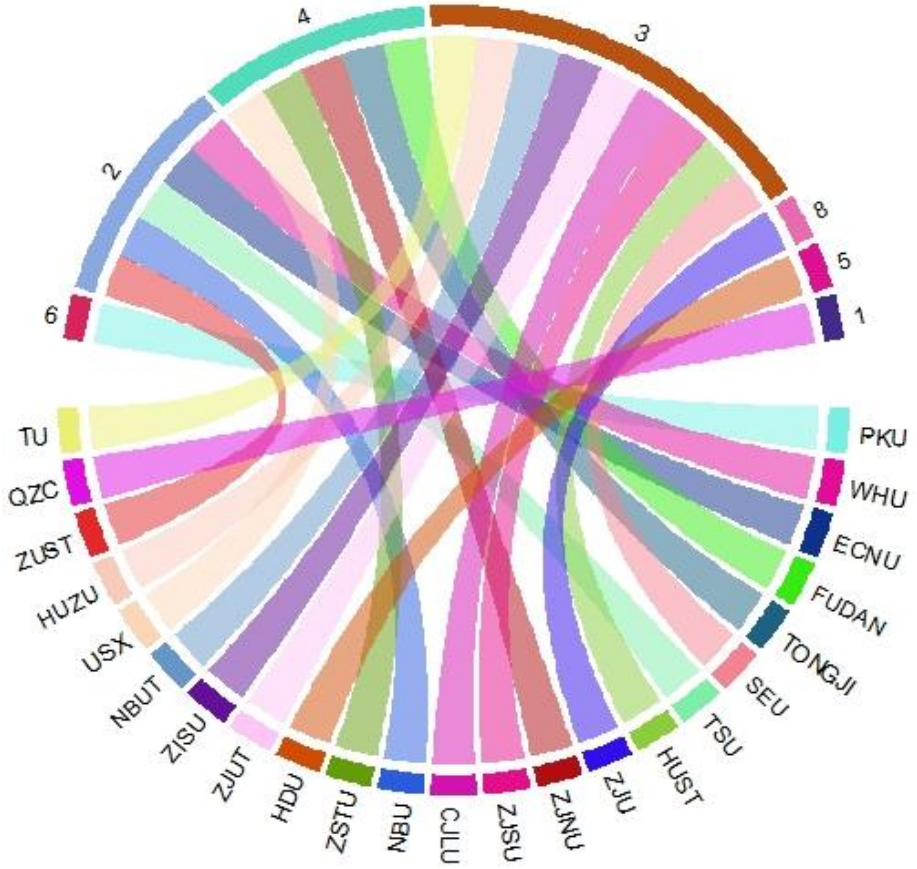

Figure 2. The number of campuses of 23 selected universities. Codes are given in Table S1.

Chinese universities use a "credit system" in their curriculum. To achieve the credit requirement for graduation, students must enroll in and finish a number of courses, each of which is worth multiple credits (mostly, 1–6 credits) [15]. In our study, 23 selected universities had an average of 164 credits needed to complete graduation over a period of four years. All courses are provided on a semester basis. To obtain one credit, students must attend 16 class hours (45 or 50 min each) for lecture courses and 32 for lab courses [15]. In Europe, for example, the ECTS grading scale is used, which is described in the European Credit Transfer and Accumulation System framework: 1 credit is a 25–30 h workload [16], and most undergraduate degrees require students to complete 180 credits over the course of a 3-year period [17]. So, the credits of two countries' programs can be roughly exchanged in this way: One credit in China equals 1.72 credits in Europe.

2.2. Statistical Analysis

We used one-way ANOVA to analyze the difference between three or more groups. We perform the homogeneity test first. A one-way ANOVA was performed to analyze the significant difference between the three levels of universities in terms of "total undergrad credits", "minor course credits", "general course credits", "disciplinary and major basic course credits", "elective course credits" and "big category" majors. Then, we performed a post hoc comparison method of variance heterogeneity to check the variance among research universities, teaching universities, and teaching–research universities on the basis of total undergrad credits.

To find out the significant difference between the various types of undergraduate course credits and "big category" majors, we used principal component analysis (PCA) to analyze the difference between 3 different types of universities, i.e., research universities, teaching–research universities, and teaching universities. We used the universities as an explanatory variable and undergraduate course credits and "big category" majors as

the response variables. The contribution of both undergraduate course credits and "big category" was displayed in cluster analysis using Heatmap (3) in R software 3.6.3. All graphical data analysis was performed using Microsoft Excel 2010 (Microsoft, Redmond, WA, USA), R software 3.6.3, and PAST 3.20 [18].

3. Results

3.1. One-Way Analysis of Variance for Various Types of Undergraduate Course Credits

As for the test variables, the total undergrad credits are significant ($p < 0.05$), which indicates that the variance of the sample is not homogenous and violates the assumption of variance homogeneity. The variance differences of the four groups of samples, i.e., "minor course credits" ($p = 0.161$), "general course credits" ($p = 0.053$), "disciplinary and major basic course credits" ($p = 0.942$), "elective course credits" ($p = 0.409$), and "big category" majors ($p = 0.644$) are not significant (Table 1), which indicates that the assumption of variance homogeneity is not violated.

Table 1. The homogeneity of variance test for "undergrad courses credits" and "big category" majors in three levels of universities.

Dependent Variable		Levine Statistics	df-1	df-2	*p*
Total undergrad credits	based on average	7.120	2	20	0.005
	median based	3.713	2	20	0.043
Minor course credits	based on average	2.010	2	19	0.161
	median based	1.477	2	19	0.253
General course credits	based on average	3.412	2	20	0.053
	median based	0.996	2	20	0.387
Disciplinary and major basic course credits	based on average	0.060	2	18	0.942
	median based	0.046	2	18	0.955
Elective course credits	based on average	0.936	2	20	0.409
	median based	0.590	2	20	0.564
"Big category" majors	based on average	0.453	2	16	0.644
	median based	0.542	2	16	0.592

The following summary in Table 2 of the variance analysis can be seen: "minor course credits" ($p = 0.169$), "general course credits" ($p = 0.643$), "disciplinary and major basic course credits" ($p = 0.237$), and elective course credits ($p = 0.668$) did not reach a significant level, whilethe total undergrad credits and "big category" majors are significantly ($p < 0.05$) differed in the three levels of universities (Table 2).

In the variance homogeneity test, the variance of the dependent variable sample of total "undergrad credits" does not meet the assumption of variance homogeneity. Table 3 is a post hoc comparison of two variance heterogeneity methods. In terms of the total undergrad credits, the test results of these two methods (Tamhane's T2 and Dennett's T3 test) shows that there is a significant difference between teaching universities and research universities ($p < 0.05$), and teaching universities have significantly higher number of total undergrad credits than research universities.

Finally, the differences in the mean values among research universities, teaching–research universities, and teaching universities in terms of the dependent variable of "big category" majors are all significant, and the former is significantly higher than the latter (Table 4). According to statistics, more than 50% of the majors in eight research universities, four teaching and research universities, and one teaching university in this study have implemented "big category" major reform (Figure 3). Engineering universities have made significant efforts in "big category" major reform. The "big category" major ratios of Tongji University are 87%, Southeast University is 88%, and Zhejiang University of Technology is 85%. Teaching universities have the fewest major training reforms, and some universities still recruit students according to majors.

Table 2. One-way analysis of variance (ANOVA) for different undergraduate courses and "big category" majors in three levels of universities.

Dependent Variable		(Sum)^2	df	(Mean)^2	F	*p*
Total undergrad credits	Between groups	584.963	2	292.482	4.868	0.019
	Within the group	1201.550	20	60.078		
	Total	1786.513	21			
Minor course credits	Between groups	257.224	2	128.612	1.959	0.169
	Within the group	1247.651	19	65.666		
	Total	1504.875	21			
General course credits	Between groups	76.490	2	38.245	0.451	0.643
	Within the group	1695.008	20	84.750		
	Total	1771.498	22			
Disciplinary and major basic course credits	Between groups	366.921	2	183.460	1.562	0.237
	Within the group	2114.317	18	117.462		
	Total	2481.238	20			
Elective course credits	Between groups	244.639	2	122.320	0.412	0.668
	Within the group	5941.777	20	297.089		
	Total	6186.417	22			
Big category majors	Between groups	8446.344	2	4223.172	14.719	0.000
	Within the group	4590.603	16	286.913		
	Total	13,036.947	18			

Table 3. Multiple comparisons of dependent variables of "undergrad credits".

Post-Hoc Comparison	(I) School Level	(J) School Level	Average Difference (IJ)	SE	*p*	95% Confidence Interval	
						Lower Limit	Upper Limit
Tam Haney T2	Research Universities	Teaching–Research Universities	−8.23	3.82	0.16	−19.24	2.79
		Teaching University	−11.68	4.21	0.048 *	−23.29	−0.08
	Teaching–Research Universities	Research Universities	8.23	3.82	0.16	−2.79	19.24
		Teaching Universities	−3.46	2.43	0.46	−10.52	3.60
	Teaching Universities	Research Universities	11.68	4.21	0.048 *	0.08	23.29
		Teaching–Research Universities	3.46	2.43	0.46	−3.60	10.52
Dunnett T3	Research Universities	Teaching–Research Universities	−8.23	3.82	0.15	−19.12	2.67
		Teaching Universities	−11.68	4.21	0.046 *	−23.20	−0.17
	Teaching–Research Universities	Research Universities	8.23	3.82	0.15	−2.67	19.12
		Teaching Universities	−3.46	2.43	0.44	−10.43	3.51
	Teaching Universities	Research Universities	11.68	4.21	0.046 *	0.17	23.20
		Teaching–Research Universities	3.46	2.43	0.44	−3.51	10.43

* The significance level for differences in means is <0.05.

Table 4. Multiple comparisons of the dependent variable "big category" majors.

(I) School Level	(J) School Level	Average Difference (IJ)	SE	*p*	95% Confidence Interval	
					Lower Limit	Upper Limit
Research Universities	Teaching–Research Universities	36.016 *	8.536	0.003	13.00	59.03
	Teaching Universities	52.111 *	11.292	0.001	21.67	82.55
Teaching–Research Universities	Research Universities	−36.016 *	8.536	0.003	−59.03	−13.00
	Teaching Universities	16.095	11.689	0.408	−15.42	47.61
Teaching Universities	Research Universities	−52.111 *	11.292	0.001	−82.55	−21.67
	Teaching–Research Universities	−16.095	11.689	0.408	−47.61	15.42

* The significance level for differences in means is <0.05.

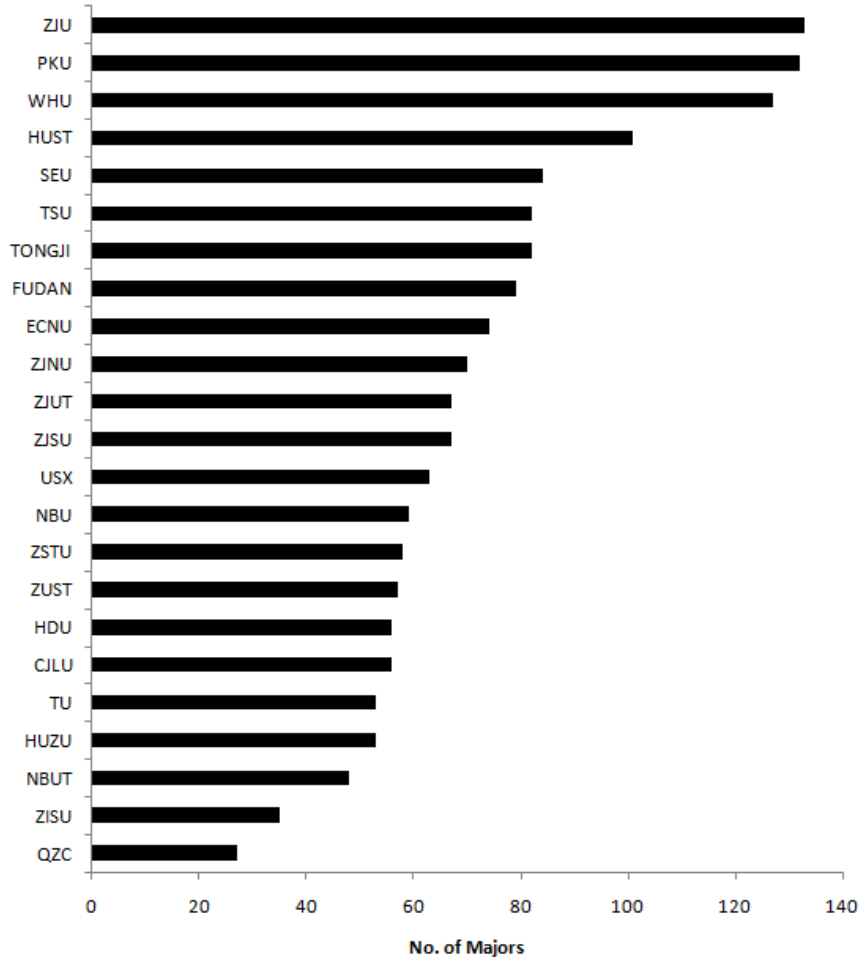

Figure 3. The number of majors of 23 universities. Codes are given in Table S1.

3.2. Cluster Analysis and Principal Component Analysis of the Undergraduate Course Credits and "Big Category" Majors

Based on undergraduate course credits and "big category" majors, research universities are separated from teaching universities and teaching–research universities. Cluster analysis revealed two groups, G1 and G2 (Figure 4). The first cluster G1 showed that all the research universities (PKU, Fudan, Tongji, ECNU, ZJU, TSU, SEU, HUST, and WHU) had similarities in the total undergrad credits, minor course credits, general course credits, disciplinary and major basic course credits, elective course credits, and "big category" majors. The second cluster G2 showed that all the teaching universities and teaching–research universities had more similarities in the total undergrad credits, minor course credits, general course credits, major course credits, elective course credits, and "big category" majors.

Principal component analysis (PCA) was performed to analyze the difference between the various types of undergraduate course credits and "big category" majors in 3 different types of universities (Figure 5). PCA showed that the first two axes have 100% variation, and "PC1-axis" has 74.2% and "PC2-axis" has 25.7% variation, respectively (Figure 5a). The significance of PCA scores was confirmed by a one-way ANOVA, which showed that research universities are significantly separated from teaching universities and teaching–research universities at the PC1-axis. As shown in Figure 5b, the variables UC ($r = 0.43$), GCC ($r = 0.44$), EC ($r = 0.46$), MC ($r = 0.30$), and DBMC ($r = 0.47$) are positively correlated with the PC1-axis, while the variables NM ($r = -0.47$) are negatively correlated with the PC1-axis (Figure 5b). As shown in Figure 5a,b, "big category" majors (NM) showed a stronger correlation with research universities, which means that research universities had a higher number of "big category" majors.

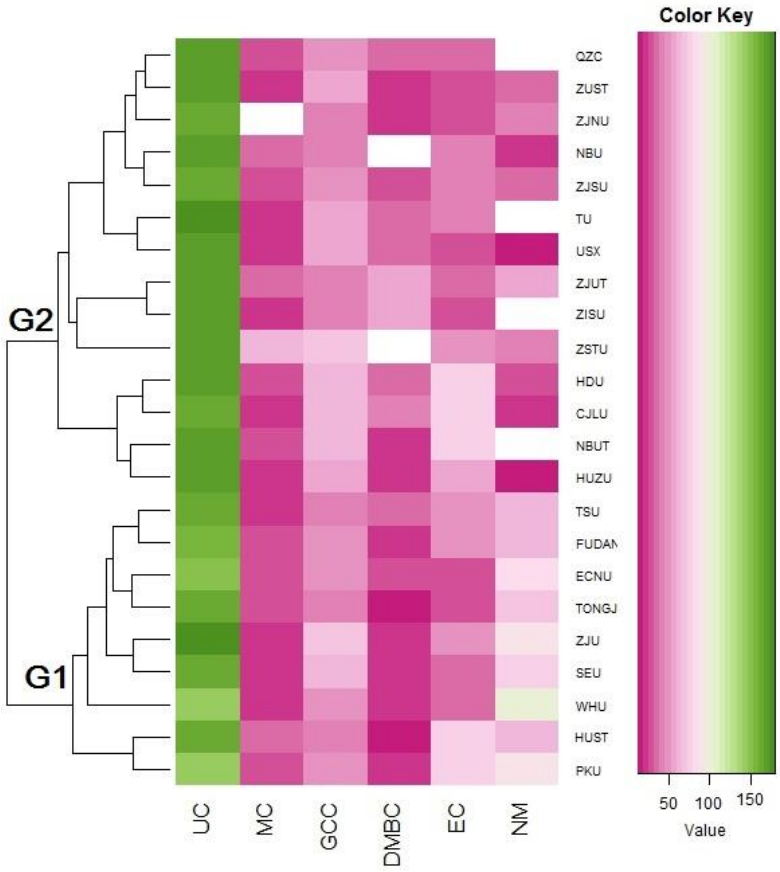

Figure 4. Cluster analysis shows the relationship between different universities with different undergraduate course credits and "big category" majors. Codes are given in Table S1.

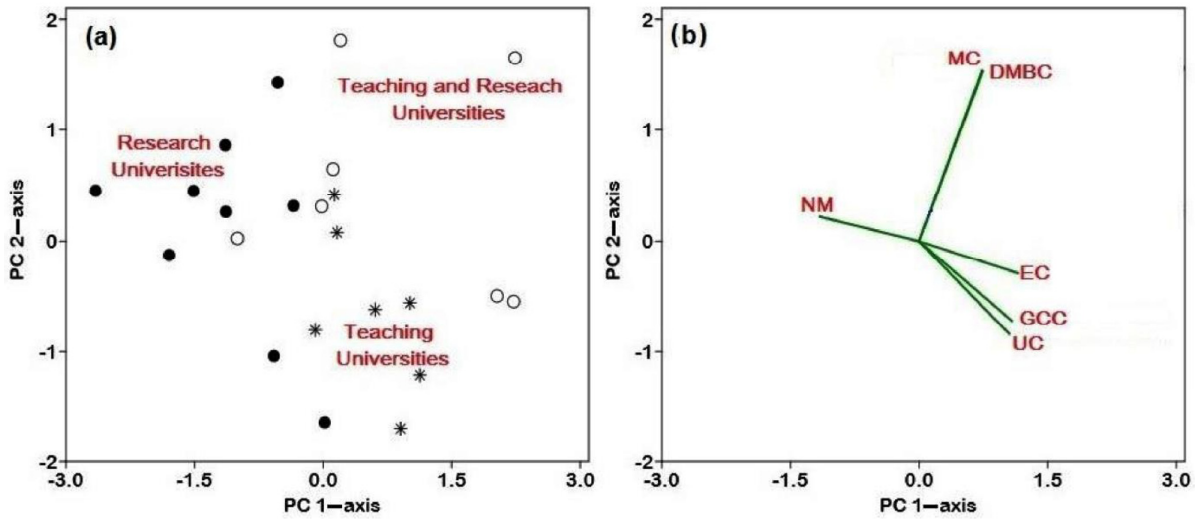

Figure 5. (**a**) Principal component analysis (PCA) showing the significant differences in the various kinds of universities, i.e., research universities (black circle), teaching and research universities (white circles), and teaching universities (stars). Points that are close together are more similar to one another than points that are far apart. (**b**) Loading of variables, i.e., total undergrad credits (UC), minor course credits (MC), general courses credits (GCC), disciplinary and major basic course credits (DMBC), elective course credits (EC), and "big category" majors (NM) shows the correlation between different undergraduate course credits with PCA axis. Each line represents a specific correlation with various kinds of universities.

4. Discussion

4.1. Overall Overview of the Credits and Their Proportions of Various Types of Undergraduate Courses in Different Universities of China

We analyzed the data of four-year undergraduate courses in 23 selected universities (i.e., total undergrad credits, public and general elective courses, general elective courses, and elective courses). The total undergrad credits showed that the four-year study burden of Chinese undergraduate students is much heavier. The total undergrad credits of 19 universities exceed 160, accounting for 82.6% of all universities (Table 5). The proportion of credits for general courses (public courses + general elective courses) in the total undergrad credits is distributed between 25% and 40%. Public courses are known as state-defined courses, which make up the majority of non-major courses. General elective course credits are scarce and dispersed. The proportion of elective course credits in the total undergrad credits at each university is relatively low. The proportion of elective course credits of 16 universities does not exceed 30%, accounting for 70% of all universities (Table 5). Elective courses (EC) are primarily skill courses, cross-disciplinary courses, and special courses that teach students how to function in society [19]. Among research universities, only Peking University has more than 50% of the elective course credits, while other research universities do not exceed 30% (Table 5). Overall, the credit ratio of elective courses is lower in research universities as compared to teaching–research universities and teaching universities. The percentage of elective course credits in some teaching–research universities and teaching universities exceeds 40% of the total credits (Table 5). Research universities should have more freedom for course selection than other universities, which is the premise of personalized talent and innovative training.

4.1.1. Curriculum System of General Education in China

The curriculum system of general education in China is arbitrary, the credits of general elective courses are limited (Table 5), and the depth is uneven. The general education in China's universities has some issues, such as "complex content, chaotic structure, poor quality, and low status" in the course content and structure [20]. Most universities divide public compulsory courses such as ideological and political, college foreign language, physical education, computer, and military courses into general courses, and some universities set separate public and general courses. Public compulsory courses are the secondary subjects of China, the West, and Malaysia [19]. As a result, the emphasis on rational spirit, thought training, value judgment, and reasoning is lacking in public compulsory courses. The proportion of general elective courses, as the real carrier of general education, accounts for no more than 8% of total undergrad credits (Table 5). Students must take two or three general elective courses from each module, akin to a "jigsaw" method [10]. General elective courses within each module are disorganized in structure and lack internal coherence. Such a modular design is devoid of meaningful knowledge integration and interdisciplinary linkage [10]. The depth of general courses varies at different levels in different universities. The general courses of research universities have the characteristics of high depth and basic principles. For example, the general courses at Peking University are "Principles of Economics", "Social Game Theory", "Introduction to Theoretical Physics", and "Principles of Aesthetics". Peking University emphasizes the "combination of general and major education" and believes that if the general courses do not have the major courses as the foundation, it is impossible to achieve the required depth. Moreover, some courses in the core general courses should be major courses for a particular major. In both teaching–research universities and teaching universities, some general elective courses have the characteristics of practicality and entertainment. Many professional teachers tend to reduce the academic depth of general courses and prefer to teach popular science and pragmatism. Using the novelty and interest of the content to resolve the monotony of the teaching only increases the stimulation of the teaching content, but the essence of "cramming" has not changed [21].

Table 5. Credits and ratios of undergraduate courses in 23 universities.

	Universities Name	Codes	Undergrad Credits	Public Courses + General Elective Courses		General Elective Courses		Elective Course Proportion
				Credits	Proportion	Credits	Proportion	
Research University	Peking University	PKU	143	47	32.90%	12	8%	51.16%
	Wuhan University	WHU	144	50	35%	12	8%	27.09%
	East China Normal University	ECNU	148.5	46.5	31.30%	12	8%	20.41%
	Fudan University	FUDAN	155	46.4	29.90%	8–12	5–8%	30%
	Tongji University	TONGJI	161.9	42	26%	8	5%	19.38%
	Southeast University	SEU	164.6	64.89	39%	10	6%	20.32%
	Tsinghua University	TSU	164.6	46	28%	13	8%	31.47%
	Huazhong University of Science and Technology	HUST	166	43.5	26%	10	6%	19.58%
	Zhejiang University	ZJU	174.3	66.3	38%	10.5	6%	27%
Teaching–research Universities	Zhejiang Normal University	ZJNU	162.6	44.8	27.60%	4	2%	17.40%
	Zhejiang Gongshang University	ZJSU	162.9	47.3	29%	12	7%	27.80%
	China Jiliang University	CJLU	165.3	63.4	38.40%	2–14	1–8%	44.60%
	Ningbo University	NBU	166	42	25.30%	6	3.60%	25%
	Zhejiang Sci-Tech University	ZSTU	167	68	41%	14	8%	30%
	Hangzhou Dianzi University	HDU	168	65.7	39.10%	10	6%	44.30%
	Zhejiang University of Technology	ZJUT	171.7	43	25%	10	6%	19.20%
Teaching Universities	Zhejiang International Studies University	ZISU	160	43.4	27.10%	8	5%	49%
	Ningbo University of Technology	NBUT	167.33	63.1	38%	8	5%	43.50%
	Shaoxing University	USX	169.1	56.8	33.60%	12	7%	18.11%
	Huzhou University	HUZU	170.2	56.4	33.10%	4–6	2–4%	32.50%
	Zhejiang University of Science and Technology	ZUST	171	53	31%	8	5%	14.60%
	Quzhou College	QZC	171.1	50.3	29.40%	10	6%	20.06%
	Taizhou University	TU	179	58	32.40%	10	6%	25.10%

4.1.2. Individualized Courses in the Developing Period

The credits of individualized courses occupy a relatively small proportion of the total undergraduate credits in the Chinese curriculum system. They leave flexible space for students to freely develop their interests, promote diversification and individualized development. Individualized courses have two requirements: first, to give students the freedom to choose courses arbitrarily and independently, and to broaden the scope of individualized elective courses from within the department to the entire university; and second, to encourage interdisciplinary and inter-professional elective individualized courses. Individualized courses are also known as self-development courses and optional elective courses in different universities and generally include interdisciplinary courses. In order to prevent students from seeking comfort in the process of course selection, some schools have set up both individualized courses and interdisciplinary courses, such as Zhejiang University, Wuhan University, Southeast University, and Ningbo University. The rigid and limited requirements of the school's personalized credits have greatly affected the students' choice of individualized subjects [22]. For instance, 12 universities in this study, mainly research universities and teaching–research universities, have set up the individualized (optional or self-developed) or interdisciplinary courses (Table 6). The average credits of independent development courses at Peking University and Tsinghua University exceed 10 credits, and most of the individualized course credits at other universities are within 10 credits (Table 6). According to our findings, 11 universities have not established individualized courses for undergraduate students. In order to achieve the objective of individualized undergraduate talent development, universities must enhance the role of the instructional system and peer effect in the selection of an individualized curriculum design for undergrad students [22]. They should also enhance the combination of individualized courses with the second classroom and "help-lead system" to enhance the educational impact of these courses.

Table 6. Independent/individualized/optional/interdisciplinary course credits in 12 selected universities.

Universities Name	Independent/Individualized/Optional/ Interdisciplinary Course Credits	Average Credit
Tsinghua University	Self-development courses 2–28	Self-Development Course 12
Peking University	Independent Elective Courses 1–28	Independent Elective Course 17
Zhejiang University	Individualized courses 6–10.5, Inter-professional course 3	Individualized Study Course 7
Wuhan University	Optional electives 10, $\geq$4 for interdepartmental courses	-
Southeast University	Individualized Courses 6–8, Interdisciplinary Courses 4–6	-
Tongji University	Personality Lessons 2–12	Personality Lesson 4
Fudan University	Interdisciplinary Development 35	-
Ningbo University	Optional electives 4, Major cross-composite course 12	-
Zhejiang University of Technology	Inter-professional Individualized Elective 2	-
Hangzhou Dianzi University	Intersection and Personality Development Credits 0–16	Intersection and Personality Development 4
Zhejiang Normal University	Personalized Lessons 2–6	Personalized Course 4
Zhejiang Gongshang University	Personalized Lessons 6	-

The reform of the individualized courses refers to the adjustment of the individualized curriculum design. In this respect, the curriculum system of individualized courses at Fudan University has been relatively effective. For example, the credits of interdisciplinary courses at Fudan University are much higher than those at other universities: Fudan University provides 35 credits (Table 6) of three paths based on general and major education such as professional advancement, interdisciplinary development, and innovation and entrepreneurship, opening up a greater space for students' personalized development.

4.2. Progressive Minor Training Models in Chinese Universities

Although undergraduate universities in China have set up minor forms of different calibers, they have built progressive minor training models, which are intended to meet

the needs of students at different levels. There are three minor training models depending on the level of certification awarded.

4.2.1. Micro-Major, Minor-Major and Minor Degree Training Model

The "course model" refers to the achievement of the prescribed conditions by studying various micro-majors in the major–minor system and issuing various course achievement certificates. A micro-major is a smaller major form than a minor major. It is a group of courses established around a specific theme, and the credit requirements are lower than those of a minor-major, ranging from 10 to 25 credits (Table S2). In a "course model", various course grade certificates are awarded to identify a student's minor level.

The "minor-major model" refers to the issuance of a professional certificate after completing the prescribed conditions by taking a minor major (second major or double major) in the major–minor system. In the "minor-major model," various professional certificates, such as minors, second majors, and double-major certificates, indicate the level of a student's minor. The credits of minor-majors are higher than those of micro-majors, and the minor credits at the 20 universities are mainly distributed between 20 and 40 credits. Among them, there are 14 universities with 20–30 credits, accounting for 70%, and 6 universities with 30–40 credits. The second major or double major (minor major) are different in terms of the titles used by different universities, but the essence is the same. They both add more major courses on the basis of the minor courses, and since the credit requirements are higher than those of the micro-major and minor-major courses, they finally get the double major certificate. The credits range from 40 to 60, and the study time usually begins in the sophomore year, with major basic courses and major courses as the main focus, supplemented by major elective courses. In this study, four universities set up second majors and double majors, respectively (Table S3). Zhejiang Normal University (ZJNU) has a total of 56 second majors, but the credits for the second major are higher than at other schools. The university has three second majors (chemistry, biotechnology (pharmaceutical), and science education) with more than 100 credits in the curriculum. The curriculum includes subject platform courses, major core courses and some major elective courses, basic practice, and professional practice.

"Degree model" refers to the issuance of a double degree or minor degree certificate by taking relevant courses in the major–minor system and meeting the prescribed conditions. In "degree model", a degree earned is an indicator of a student's minor. A minor degree requires more credits than a minor, and some schools also require participation in practice, a graduation thesis, or design. A dual degree is essentially the same as a minor, but the credits are slightly higher than the minor. The six universities in this study set up a minor degree with a credit distribution of 30–55, and seven universities set up a double degree (Table S4) with credits ranging from 38–76. Peking University has strict requirements on the study time of double majors. Students must take double majors beginning in their second or third year of high school. They cannot apply for two majors with similar disciplines as double majors. After the completion of the major, the minor degree program is terminated at the same time, whether or not they graduated from Peking University. However, other universities generally extend the study time of the minor degree or double degree to the maximum study period.

4.2.2. Implementation of Minor Learning Methods in Undergraduate Education

China's undergraduate minor systems are considering the differences in students' learning levels and abilities and are building an advanced minor talent training system. When comparing the proportion of students pursuing minor or dual degrees with full-time undergraduates, we found that research universities are more prevalent than other universities (Table S5). In this study, students studying minor courses at Zhonghua University of Science and Technology accounted for the highest proportion of full-time undergraduates, at 3.18%, and students at Peking University taking double degrees accounted for the highest proportion of full-time undergraduates, reaching 20.03%. The sum of the proportion

of students taking minor or double degrees at Peking University is far ahead, reaching 20.58%, while the proportion of students at the other five universities is less than 4%. In the 2020–2021 academic year, Peking University had 3297 double-degree students, accounting for 90% of the actual number of undergraduate graduates in 2021 (3645 people), much higher than the 10% of East China Normal University's undergraduate graduates who obtained minor degrees each year. In Chinese universities with heavy learning, elite university students, especially at top research universities, have the ability to take minors and double majors, but the scale of minors in general universities is still small. The statistics showed that the proportion of students taking minors and double degrees in universities is relatively small as a whole, and the learning method of minors needs to be popularized. The main reasons that hinder students from choosing a minor study method are the high pressure of double-major study, the poor quality of minor courses, the inflexibility of class time and duration of study, the unsatisfactory course setting method, and the fear of low social recognition of the minor [23]. The minor and the major study are not related to each other, and there are some problems of disconnection; the timing of the major and the minor is conflicting, the minor courses are short in class, the content is too full, and the requirements of the teaching content are low [24].

4.3. Major Transfer Policy Based on Strong Major and Weak General Education Management System

The major transferring of undergraduates in Chinese universities started in September 2002 at Fudan University [25]. Transferring majors is an opportunity provided by universities for students to explore and identify interests that are appropriate to their interests, abilities, and personalities. Although the undergraduate transfer program advocates "no threshold for transferring out" and "conditions for transferring in", the actual number of students transferring majors is small, and the success rate does not reach 100%.

The 13 universities in this study released the annual number of students who transferred majors (Table 7). Statistics found that the proportion of students who successfully transferred majors among the 13 universities accounted for less than 4% of the undergraduate students (Table 7). In some universities, students are not as motivated to transfer majors as expected. Zhejiang University of Science and Technology provided the number of students (2212) who can transfer the major, accounting for 13.12% of all undergraduate students, and 760 applicants actually applied for major transfer, accounting for 4.51% of regular undergraduate full-time students. The success rate of students transferring majors is less than 100%. In the 2020–2021 academic year, Zhejiang University of Science and Technology applied for 760 major transfer applications, 632 of which were successfully transferred, for an 83.16% success rate. Hangzhou Dianzi University had 1495 applicants for transferring majors, and a total of 709 people have been successfully transferred, for a success rate of 47%. In Zhejiang Normal University, a total of 1170 applicants applied for major transfer, and 432 were successfully transferred, for a success rate of 37%. Of the 186 students from Ningbo University who applied to transfer majors, 169 applicants were successful, for a success rate of 91%. In the 2019–2020 academic year of China Jiliang University, 491 applicants applied for transfer majors, and 306 students were successfully transferred, for a success rate of 62.32%. Through the independent transfer of major, students can be shifted from passive to active learning, increase their passion for learning, and support the reform of educational management in higher education [25].

Table 7. The number and proportion of the students who transfer majors in a certain academic year in 13 selected universities.

Name of Universities	Time: School Year	Number of Students Who Transfer Major	% of Full-Time Undergrad Students
Huazhong University of Science and Technology	2020–2021	571	1.94%
Beijing University	2020–2021	203	1.23%
East China Normal University	2020–2021	356	2.41%
Hangzhou Dianzi University	2020–2021	604	3.96%
Zhejiang Gongshang University	2020–2021	552	3.42%
Zhejiang Normal University	2020–2021	432	2.28%
China Jiliang University	2019–2020	306	2.04%
Ningbo University	2020–2021	169	0.91%
Zhejiang Sci-Tech University	2020–2021	508	2.77%
Zhejiang University of Science and Technology	2020–2021	632	3.74%
Quzhou College	2019–2020	82	1.30%
Ningbo University of Technology	2020–2021	177	1.24%
Zhejiang International Studies University	2017–2018	50	0.65%

However, there are many difficulties for undergraduate students to transfer majors, i.e., the small number of undergraduate students, the low success rate, and the low enthusiasm due to the restrictions of their access conditions to transfer the major. The course grade points and rankings of original majors in the assessment method occupy a high proportion of the assessment of transferring majors, and some universities even set students with the top grade point rankings to have the privilege of transferring majors. Furthermore, the limited number of opportunities to transfer majors (most institutions provide one), the limit on the number of voluntary applications, grade restrictions, and the move to downgrade for transferring majors have all created barriers for students to transfer majors. If transferring majors is not a feasible option, several experts advised students to choose another method of studying the major in the major admission system. It particularly refers to the learning approach in which students consider alternative majors while studying the basic major, and on the basis of not violating the basic major's learning standards, they can select the intended other major courses [26].

The difficulty in transferring majors stems from a strong major and a weak general education management system. The difficulty in transferring majors lies in the fact that it cannot get rid of the fixed pattern of major education management and the path dependence of interest solidification formed under the planned economy in the past [27]. Although the removal of the restriction on transferring majors has significantly increased the proportion of students applying to transfer majors, the competitive pressure on students to transfer majors has not decreased. The undergraduate major transfer policy only removes the transfer out requirement, not the transfer requirement for faculties. However, there is still a paradox that students who have no interest in a major can get excellent results in their first major and have more advantages if they transfer [28]. The undergraduate major transfer policy, with its weak general education and strong major education, does not provide students

with more opportunities to transfer their major, which is detrimental to the development of their personality and interests as well as the acquisition of interdisciplinary knowledge.

4.4. Exploring the Paths for Major and General Education Integration

4.4.1. Different Aspects of Undergraduate Education Integration in China

As compared to subject-based education, integrative education fosters the development of broad "intellectual programs" that encourage students to use their knowledge and skills in a novel way [29]. Nowadays, integrative education is a new trend in the reform of undergraduate education in American research universities. Therefore, undergraduate education in China requires an integrated education of interdisciplinary knowledge and skills and needs to be integrated on the basis of three aspects:

(a) Integration into an effective combination of major education and general education:

First of all, we pay attention to the general nature of major education, refine the content of general thinking training, and value education in major education. Disciplinary and major basic courses should construct a curriculum system according to the academic relationship and development trend of different disciplines or majors, follow the educational concept of general education, strengthen the connection with major education, and truly reflect the nature of the connection.

Secondly, general education should run through the undergraduate education process, but it is emphasized that general education is not equivalent to "pan-professionalism" and "professional nihilism", and it is necessary to connect and improve major education, but also to be independent of major education. General education is not only a curriculum but also a life-long philosophy, attitude, and learning style. It should expand general education course options to allow students to fulfill their general education needs and interests in each major area, and set up comprehensive general courses at different levels and across multiple academic fields around the theme to ensure the integrity and relevance of students' knowledge systems. In addition, the interdisciplinary academy life and learning environment that all students face should be integrated, avoiding the elite tendency of the academy life, and realizing the integration of structured and unstructured education through the reorganization of the accommodation space and the creation of the accommodation culture.

(b) Major integration based on multiple disciplines:

Undergraduate majors in China are mainly single-disciplinary, and the construction of real interdisciplinary majors and individual majors is still in the exploratory stage. To implement the combined major–minor systems, we can combine the minor courses into major degrees and set up integrated dual majors, which can increase the connection between the major and minor systems, maintain the enthusiasm of students to learn the minor courses, and reduce the turnover rate. Most of the majors or directions in Western universities are problem-oriented, so most majors are interdisciplinary [30]. Dual- and three-discipline major courses account for a greater proportion of Oxford University's 50 undergraduate majors than single-discipline major courses, reflecting the modern knowledge development trend of differentiation and integration as well as the results of the interdisciplinary formation of a large number of marginal disciplines [31].

(c) Curriculum integration based on real problems:

The reform of the curriculum structure of China's undergraduate courses is mainly to appropriately increase the number of disciplinary and major basic courses, general courses, inter-disciplinary courses, and individualized courses. However, its course content and structure remain focused on a single subject, with a strict logic system and a pre- and post-study relationship, and are separated from the practice of complex problems. Curriculum integration is at the core of undergraduate integrated education in American research universities nowadays, and its forms in undergraduate curriculum integration include interdisciplinary courses, research project courses, spiral courses, and capstone courses [32]. The common characteristics of these course integration forms are setting real-

world problem situations, focusing on teamwork, using research-based learning methods, and integrating multidisciplinary methods and perspectives.

4.4.2. Reforms in the Undergraduate Education for Improving Quality and Rationalizing the Course Structure

There are high credit requirements for degree completion in China. As can be seen from the above, there is a significant difference regarding the average value of total "undergrad credits" among teaching universities, teaching–research universities, and teaching universities. In this study, the upper limit of the average credits for the total number of courses taken by Chinese universities in each semester is about 33 credits, and the lower limit of the average credits is 15 credits. To compare with American universities, they require no less than 12 credits and no more than 18 credits per semester, which is lower than Chinese universities. According to Lu and Weng [33], American universities adopt a two-semester or three-semester system; the former is 30–32 credits per academic year, and the latter is 45–48 credits per academic year.

Chinese undergraduates are caught in heavy study pressure and discipline-style busyness and have cultivated the characters of diligence, perseverance, and patience, but they have not been able to cultivate wisdom, great love, calmness, or the ability to create meaning. The heavy curriculum occupies and binds students' hearts to death, leaving no "gap" for students to feel and grow on their own. Aristotle believed that "man's nature seeks not only to be competent for work but also to enjoy leisure ... even if both are necessary, leisure is more worthy of choice and is the purpose of work" [34].

If the undergraduate courses are comprehensive and large, it will affect the students' in-depth learning. The curriculum system should be more concise, the credits should be rationally controlled, the content should focus on the mutual coordination of depth and breadth, and the goal should focus on ability training. Some researchers compared the "deep learning of major courses" and its impact mechanism among the undergraduates of first-class universities in China and the United States and proposed that China's major education should reshape the learning quality concept of major courses, enhance the learning participation of major courses, and improve the difficulty of learning requirements of major courses [35].

High-quality course curricula may convey information by emphasizing the development of competencies and transferrable skills; they also support teaching methods such as heuristics, inquiry, discussion, and interactive learning to foster students' higher-order thinking. It is necessary to open more thoughtful, intelligent, and ability-based courses with profound backgrounds rather than simple general, recreational, and skill-based courses [36].

4.4.3. Different Aspects of Effective Combination of General and Major Education

The relationship between general and major education varies based on different levels and positioning of universities and the different disciplines and majors [37]. Within the universities, majors with a higher admission rate should focus on major basic education. Majors with a specific occupational nature should open comprehensive general courses at the level of maintaining specialization to broaden the professional dimension. Majors such as humanities and social sciences have a strong emphasis on developing general skills and connecting major education through general education. Both research universities and teaching–research universities should increase the capacity of "big category" majors to strengthen the ability to aggregate the advantages of unpopular majors. Teaching universities should select the school's advantageous and characteristic majors for "big category" training.

Teaching–research universities can start major selection at the end of the first or second semester, while research universities can start major selection at the beginning of the first or second year. The higher the level of the university, the longer the major selection period must be delayed.

According to their own student characteristics and school resources, research universities, teaching–research universities, and teaching universities are encouraged to strengthen the cultivation of students' compound knowledge and skills at the three levels of double degrees (minor degrees), minor-majors (double majors or second majors), and micro-majors, respectively.

4.4.4. Increase Students' Freedom of Choice in Undergraduate Instructional Management

Compared with general education, China's major education training program is more "stable" and "mandatory". The proportion of major compulsory courses with strictly regulated content and order among all major credit requirements is much higher than that of first-class universities in the United States [38]. The space for free choice of courses for undergrads in China is still small. In this study, elective course credits accounted for no more than 30% of the total undergrad credits at 2/3 of the participating universities. Although China's undergraduate education has increased the right to choose freely in terms of majors, courses, processes, and teachers, however, many conditions remained. The form of free choice in the system has become more and more perfect, but in practice it is "prohibitive". In the name of freedom of choice, students are subjected to increasingly demanding selections. As Bloom pointed out, the "free" education of people's right to make their own choices is now expanded, but in fact it does not realize the true "freedom" of the mind [39].

The student-centered undergraduate education philosophy requires that learners should be given moderate freedom to learn the development plan and take responsibility independently, satisfy students' intellectual interests and aspirations, and develop their own individuality. However, universities cannot completely indulge the freedom of students. Complete freedom will lead to disorder and shallowness, and the price of free choice will entail certain responsibilities. The consumption logic of free choice can easily lead to "hard training" and "hard work" being avoided [40]. Positive freedom can only be obtained through hard training and discipline, and it can achieve the Confucian state of having its place, making the best of one's nature, and establishing oneself as one. It is necessary to release appropriate freedom in many aspects, such as further reducing the credits of compulsory courses and increasing the proportion of elective courses; setting up more types of courses, especially inter-professional, individualized, research-based courses, etc. The major transfer system is based on interests, achievements, abilities, and qualities. We must refine the rough and unified teaching management to meet the learning needs of different students in order to implement a flexible credit system.

Learning freedom is an essential component of academic freedom since it represents the rehabilitation of learners' subjectivity in the learning process [41]. University students should be given more freedom to transfer majors, take courses, attend lectures, engage in discussion and research, and develop their knowledge. The corresponding strategies include: (1) Standardizing the teaching management of changing majors and the freedom to transfer majors within the school shall be appropriately expanded on the premise of fairness, justice, and reasonableness using methods such as secondary assessment on campus, competitive selection, and survival of the fittest; (2) Increasing the proportion of elective courses, fully realize course selection freedom, and gradually achieving an equal division of compulsory and elective courses; (3) Reforming teaching methods, giving students the freedom to discuss and question, and adopting heuristic, problem-based, discussion-based, practical, and other vivid teaching methods; (4) Reforming management methods and expanding the freedom to listen to lectures. Students may apply not to engage in the course lectures or listen to a portion of the course content, but they must participate in the course evaluation in order to actively cultivate their knowledge.

5. Conclusions

As the dominant major education model in China, general education is squeezed and weakened in quantity and quality, and the concept of general education is difficult to

implement in practice. In our study, we discussed three major problems of strong majors and weak general education: (1) the higher number of total undergrad credits and the small proportion of elective courses, general elective courses, and individualized courses; (2) the difficulty of popularizing the progressive minor training model; and (3) the restrictions in the major transfer system. To resolve these problems, the universities must reform the undergraduate education to reduce credit burden and improve quality of the diversified combination of general and major education, appropriately increase students' freedom of choice for selection of majors and courses for an effective combination of "general and major education", and then bring the undergraduate education to a characteristic and high level.

In our study, teaching universities are inferior to teaching–research universities and research universities in terms of the concentrations of "big category" majors, the study of disciplinary and major basic courses, the depth of general education courses, and the organization of coordinating general education and major education. Looking at the situation investigated in three kinds of universities, management can focus on strengthening the construction of general education and major curricula, and gradually move from the micro to the macro view. This is an effective method for realizing the objectives of general education.

There are three ways to promote the integration of general education and major education: (1) to reform general education, universities should set up general courses and cooperate with major education. For instance, general courses such as humanities and social sciences have a strong emphasis on developing general skills and connecting major education through general education; (2) to reform major education, universities should absorb the concept of general education, broaden the caliber of major education, and pay attention to the cultivation of students' comprehensive qualities; (3) to achieve mutual progress, general education and major education should be reformed at the same time so that both can absorb the mutual advantages of educational concepts, and form a dynamic harmony. Furthermore, universities should explore the inclusion of highly integrated major courses into the general curriculum system, develop education and teaching activities with both general and major education, implement the requirements of general education into the implementation plan of major curriculum teaching, and establish an education and teaching system in which general and major education support each other.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su15021251/s1, Table S1: The number of campuses of 23 selected universities; Table S2: Micro-major settings in 9 universities; Table S3: Credits for second major/double major in 8 universities; Table S4: Minor degree/dual degree credits in 13 universities; Table S5: The number and proportion of students taking minors or double degrees as compared to full-time undergraduate students in 7 universities.

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References

1. Li, L.-X. The influences of the soviet educational model on the education of PR China. *Asia Pac. Educ. Rev.* **2001**, *2*, 106–113.
2. Liu, W.; Ma, R. Regional Inequality of Higher Education Resources in China. *Front. Educ. China* **2018**, *13*, 119–151. [CrossRef]
3. Bie, D.; Liu, J. Temporary action or new model experiment? Teaching at Chinese universities in the time of COVID-19. *Int. High. Educ.* **2020**, *102*, 18–20.
4. Xiong, W.; Yang, J.; Shen, W. Higher education reform in China: A comprehensive review of policymaking, implementation, and outcomes since 1978. *China Econ. Rev.* **2022**, *72*, 101752. [CrossRef]
5. Li, X. The Analysis of the Development Background and Strategy of Local Application-oriented undergraduate. In Proceedings of the International Conference on Logistics Engineering, Management and Computer Science (LEMCS 2015), Shenyang, China, 29–31 July 2015; pp. 818–822.
6. Zhou, T.; Law, R.; Lee, P.C. Exploring Sustainable Measurements of Academic Research: How Do Faculty Members in Teaching-Oriented Universities of China Evaluate Good Research in Tourism and Hospitality? *Sustainability* **2021**, *13*, 11129. [CrossRef]
7. Fang, W. The development of transnational higher education in China: A comparative study of research universities and teaching universities. *J. Stud. Int. Educ.* **2012**, *16*, 5–23. [CrossRef]
8. Hou, D. Towards more open general education in universities. *High. Educ. Dev. Eval. J.* **2020**, *5*, 34–44.
9. Yan, K.; Zhang, Y. The tensions of general education reform in China. *Asia Pac. Educ. Rev.* **2022**, *23*, 1–12. [CrossRef]
10. Meng, W.; Huang, W. Institutional problems and solutions of general education in Chinese universities. *Chin. Educ. Soc.* **2018**, *51*, 21–28. [CrossRef]
11. Zhou, H.; Zhu, Y. Major outcomes and revelations of recent research on postgraduate education in China. *J. Grad. Educ.* **2020**, *2*, 1–5.
12. Li, M. *General Education—A View of University Education*; Tsinghua University Press: Beijing, China, 1999.
13. Fang, H. How to mutually advance general education and major-based education: A grounded theory study on the course level. *Chin. Educ. Soc.* **2018**, *51*, 68–80. [CrossRef]
14. Li, M. The reform trend of engineering talents training model facing the new industrial revolution. *Res. High. Educ. Eng.* **2016**, *5*, 57–65.
15. Yao, Z.; Yan, T.; Hu, M. Comparison of undergraduate chemical engineering curricula between China and America Universities based on statistical analysis. *Educ. Chem. Eng.* **2022**, *38*, 55–59. [CrossRef]
16. Baratovich, B.B. The role of credit-module systems in increasing the quality of education. *Gospod. Innov.* **2022**, *24*, 585–589.
17. Hilburn, T.B.; Thiriet, J.-M.; Kornecki, A.; Grega, W.; Sveda, M. Credits and accreditation in the USA and Europe: Towards a framework for transnational engineering degrees. *Innovations* **2008**, *2008*, 29–42.
18. Hammer, Ø.; Harper, D.; Ryan, P. Paleontological statistics software: Package for education and data analysis. *Palaeontol. Electron.* **2001**, *1*, 9.
19. Yu, X. The Reform and the Future of Chinese Philosophy Education. In Proceedings of the 2019 3rd International Conference on Economic Development and Education Management (ICEDEM 2019), Dalian, China, 14–15 September 2019; pp. 127–132.
20. Pang, H. The predicament and outlet of general education curriculum construction. *Jiangsu High. Educ.* **2010**, *2*, 63–66.
21. Lv, H. General education in the perspective of "strong foundation program". *Jiangsu High. Educ.* **2021**, *6*, 68–77.
22. Lu, X. Research on the Current Situation and Countermeasure of the Personalized Curriculum for Undergraduates Taking Southwest Petroleum University as an Example. In Proceedings of the 4th International Conference on Contemporary Education, Social Sciences and Humanities (ICCESSH 2019), Moscow, Russia, 17–19 May 2019; pp. 602–605.
23. Huang, Y.; Fan, K. Design of undergraduate minor learning system from perspective of students' development need. *Res. High. Educ. Eng.* **2022**, *1*, 151–156.
24. Zhao, Q.; Xiang, C. *The Effect of Undergraduate Teaching Reform in Colleges and Universities*; South China University of Technology Press: Guangzhou, China, 2021.
25. Jingyi, Z.; Yi, P. A review on college transfer majors and their English learning motivations. *Int. J. Engl. Lit. Soc. Sci.* **2021**, *6*, 185–192. [CrossRef]
26. Yan, J.; LI, D. The trends and debates on the undergraduate categorized cultivation mode reform in Chinese universities. *Mod. Educ. Manag.* **2020**, *7*, 30–37.
27. Gu, J.; Jiang, M.; Huang, Y. Study on the satisfaction mechanism of students' major switching in colleges. *Res. Educ. Dev.* **2022**, *3*, 15–24.
28. Ma, L.; Zhang, X. How does the policy of freely changing majors affect students' behavior of changing majors. *J. Educ. Sci. Hunan Norm. Univ.* **2021**, *4*, 93–103.
29. Walker, D. Integrative Education. *Res. Roundup* **1995**, *12*, n1.
30. Cai, J. New concept of construction of first-class undergraduate courses and majors. *J. Northest Norm. Univ.* **2020**, *3*, 7–12.
31. Zhou, C. *History of Oxford University*; Shanghai Jiaotong University Press: Shanghai, China, 2012.
32. Wu, L. *The Transformation of "Learning Paradigm" in Undergraduate Education*; Science Press: Beijing, China, 2021.
33. Lu, C.; Weng, D. First year phenomenon: A study of first year curriculum from the perspective of undergraduate transcripts. *China High. Educ. Res.* **2022**, *5*, 27–33.
34. Aristotle. *Politics*; Wu, S., Translator; Commercial Press: Beijing, China, 1965.

35. Lv, L.; Gong, F. The comparison of "deep learning of major courses" and its influence on the first-class university students between China and US. *Jiangsu High. Educ.* **2021**, *1*, 78–88.
36. Song, D.; Wang, L. What is not general education? *Forum Contemp. Educ.* **2017**, *5*, 32–39.
37. Liu, X.; Zhao, C. Growth in integration: The path exploration of cultivating application-oriented talent. *J. High. Educ.* **2022**, *1*, 79–85.
38. Ding, J. Between load reduction and pressure increase: Changes in the number of undergraduate courses. *TsingHua J. Educ.* **2020**, *3*, 129–139.
39. Bloom, A. *Giants and Dwarfs*; Qin, L.; Lin, G.; Yan, B., Translators; Huaxia Publishing House: Beijing, China, 2011.
40. Liu, Y. Free choice and institutionalized selection: Elite cultivation in mass higher education-a case study based on Peking university. *Peking Univ. Educ. Rev.* **2017**, *4*, 186.
41. Macfarlane, B. *Freedom to Learn: The Threat to Student Academic Freedom and Why It Needs to be Reclaimed*; Routledge: Abingdon, UK, 2016.

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The Knowledge and Perception of Sustainability in Livestock Systems: Evidence from Future Professionals in Italy and Argentina

Andrea Beatriz Damico [1,2], Margherita Masi [3,*], José María Aulicino [2], Yari Vecchio [3] and Jorgelina Di Pasquale [1]

[1] Faculty of Veterinary Medicine, University of Teramo, Piano D'Accio, 64100 Teramo, Italy
[2] Faculty of Agricultural Science, National University of Lomas de Zamora, Ruta Provincial 4 Km 2, Llavallol, Buenos Aires B1836, Argentina
[3] Department of Veterinary Medical Science, University of Bologna—Alma Mater Studiorum, 40064 Bologna, Italy
* Correspondence: margherita.masi4@unibo.it

Abstract: The preference of consumers for more sustainable consumption patterns has a great impact on what and how food is produced. Consumers' interest in sustainable agricultural products can drive this type of production, and the primary sector should take advantage of this opportunity to propose new paradigms in the supply of livestock products. Although sustainable alternatives can be imposed through rules or regulations, it is important that market forces act through consumer choices so that the development of the sector may have long-lasting effects. Professionals involved in the primary sector and, in particular, in livestock production must be trained to face the new challenges of the sector and meet market demands. Improving production with a view to sustainability is one of the challenges that need to be addressed at a global level. The present study investigated the perception and knowledge of sustainability of some future professionals in the sector to understand whether the academic training delivered to them is suitable. The results show that respondents have partial knowledge of sustainability, especially of its environmental dimension. Their idea of sustainability is particularly linked to the extensification of production rather than sustainable intensification, and only marginally do they consider the social and economic dimensions of sustainability. Less knowledge of the social and economic components is particularly relevant if sustainability is pursued through an extensive approach that leads to an inevitable reduction in production. The academy must act to improve the knowledge of sustainability in its three main components in an essential balance.

Keywords: sustainable development; environmental sustainability; economic sustainability; social sustainability; students' perspective; future practitioners; education; sustainable livestock

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1. Introduction

The livestock sector is under the magnifying glass of all environmental observers, who are increasingly demanding that it move towards more sustainable models. In addition, consumers have begun to change their consumption habits, increasingly demanding products that demonstrate a commitment to a more sustainable model, that is, they call for "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. All this suggests the need to understand whether the technicians and future professionals involved in the livestock sector have sufficient knowledge of the subject to be able to provide support to livestock farming facing this challenge.

To mitigate the damage caused by climate change, shifts in traditional production systems, still based on linear economic models, have been proposed internationally, orienting them towards more sustainable and circular development. Already in 2015, the United Nations [2] called for economic sectors to contribute to achieving global sustainable devel-

opment goals, while in 2020, the European Farm to Fork strategy announced an ambitious environmental legislative proposal to make the agri-food system more sustainable.

Many authors mention that livestock production and, in particular, meat production massively contribute to global warming and environmental degradation [3,4], since the livestock system is recognised as an important source of emissions of anthropogenic greenhouse gases and makes intensive use of chemical inputs, antibiotics and raw materials for feed [5,6]. These hypotheses are difficult to demonstrate because, as stated in the scientific literature, the environmental impact of animal protein production varies according to the species raised and the production system used, even within similar production methods [6–8]. Poore and Nemecek indicate that such variability is due to the heterogeneous characteristics of the agricultural sectors, including differences between producers from the same geographic regions and between countries with developed and emerging economies, also attributed to the different traceability systems and regulations concerning the livestock system in the various countries [9].

There is no consensus in the scientific community on what the most sustainable production system is, and it is necessary to unify the methodology to study the subject matter, including all the factors that determine it [9]; however, consumers are concerned about the production system and require greater attention from the productive sector [10,11], increasingly demanding that social, ethical and environmental issues be addressed [12,13].

The preference of some consumers for more sustainable consumption patterns [14] has a great impact on what and how food is produced [15]. The consumption of foods of animal origin entails a complex, dynamic process [16] that is highly controversial for ethical and environmental reasons [10,17], and frequently, the patterns of behaviour are not unambiguously consistent with attitudes [13]; however, consumers' interest in sustainable agricultural products can drive this type of production, and the primary sector should take advantage of this opportunity to propose new paradigms in the supply of livestock products. Although sustainable alternatives can be imposed through rules or regulations, it is important that market forces act through consumer choices [15] so that the development of the sector may have long-lasting effects.

Studies in the international literature often focus on the point of view of companies (drivers and barriers), consumers or civil society, but little attention is given to what employees (current technicians, i.e., not managers) and future professionals think. In order to gain a broader understanding of how to meet the demands of consumers, civil society, policymakers, and all those who actively work and will work in the livestock sector, it is now necessary to also investigate the perspectives of those who have received less attention in studies on the sustainability of animal production.

This research is part of a broader study on sustainability that investigates how much the technicians involved in the three fundamental dimensions of sustainability (environmental, social and economic) know about the subject matter [18]. The results of the first study indicated that there were no differences in the knowledge of sustainability between students majoring in different fields (economics, social sciences and agricultural sciences). Students exhibited greater knowledge of the environmental dimension of sustainability than of its social and economic components.

This second study is oriented towards the animal protein sector, as it is held to be the main culprit of environmental impact. The aim of this study was to analyse the perception and knowledge that young future professionals engaged in the primary sector have about both the three dimensions of sustainability and the perceived level of sustainability of livestock production, in order to understand if, through academic training, future professionals have a broad and multidisciplinary and holistic understanding of the concept of sustainability and possess the tools to support the primary sector in pursuing sustainable development. Students of technical-scientific subjects related to animal production (e.g., agronomy, animal husbandry, veterinary medicine and technicians or graduates in animal production sciences) must receive proper training to be able to develop more sustainable solutions [19]. University education plays an essential role in training responsible pro-

fessionals by teaching the knowledge, skills and values that contribute to the sustainable improvement of the world [20]. Therefore, this research focuses on university students training in the field of animal production at the National University of Lomas de Zamora (Buenos Aires, Argentina) and the University of Teramo (Italy), namely future workers and decision makers who will contribute to shaping the political, social, environmental and economic spheres [21] in two key countries for livestock production.

Argentina is one of the main international exporters of beef, milk, chicken meat and pork. In addition, the total domestic consumption of animal proteins is higher in this country than the average consumption in Mercosur countries [22]. On the other hand, Italy is one of the main producers of organic food in Europe [23], aiming at increasing production in line with the objectives of the Green Deal [24].

An analysis of the knowledge and perception of sustainability of future professionals will make it possible to fill a gap in this area and understand whether their training is adequately preparing them to face the challenges. In addition, comparing the students in these two countries may help understand whether developing countries with high productivity of raw materials differ from developed countries already oriented towards sustainable production and seeking to increase and improve it.

2. Materials and Methods

Between April and June 2021, a survey was carried out using CAWI (computer assisted web interviewing) methodology among students in university courses related to animal production (agronomy, animal husbandry, veterinary medicine and graduates in animal production sciences, etc.) at the National University of Lomas de Zamora (Buenos Aires, Argentina) and the University of Teramo (Italy).

The questionnaire was one used in a previous investigation [18] with some modifications incorporating questions about animal production. A pilot test of the questionnaire was carried out with a small group of people (n = 20 in each country) belonging to the target population, as indicated in the literature [25]. Staff from the faculties involved sent the link to the questionnaire to all students enrolled in the mentioned courses. The entire target population was contacted by email (1312 Argentine students and 851 Italian students). Participation in the survey was voluntary, and participants signed their informed consent.

A probabilistic sampling was carried out among both populations. In order to reach the confidence level of 95%, the margin of error of 5%, and heterogeneity of 50%, the expected completed surveys were 298 for Argentina and 265 for Italy. The database was managed with Microsoft Excel, and analyses were performed with Infostat software version 2020 [26].

The survey consisted of three thematic sections and a total of 43 questions, as follows:

Section 1. Demographic and personal characterisation: The demographic characteristics of the respondents were first obtained.

Section 2. Perception and knowledge of sustainability and its dimensions: This section included questions about the degree of respondents' concern about the sustainability of the planet. Subsequently, to analyse their spontaneous idea of sustainability, the respondents were asked to write the first word that came to mind in response to a cue word, "sustainability". Then, to analyse their views about different aspects of the subject matter, they were asked to rank the perceived importance of 12 proposed statements related to the three dimensions of sustainability and, successively, to identify the three dimensions that make it up, within a proposed list. The respondents were next asked about how easy to understand the concept of sustainability was and to what extent they agreed with the statement "The concern for sustainability has the potential to cause changes in the production system". They were also asked to mention where they obtained information about the subject and to self-assess their own knowledge of the topic.

Section 3. Perception of the level of sustainability of animal source foods: The perception of the level of sustainability applied to livestock production was specifically

investigated. The perception of sustainability of production at the national level was analysed for the following nations: Argentina, Italy, the United States, Brazil, China and the European Union. Subsequently, the animal husbandry production chains (beef and dairy cows, chickens and pigs) were investigated, differentiated by production system (field/extensive or confined/intensive). The questions then inquired into the respondents' perception of the need to improve these production systems. They were asked to mark which of the following changes were necessary: "improving the quality of the food given to the animals", "eliminating the excessive use of medication/antibiotics", "improving the breeding environment", "improving the treatment of animals throughout the life cycle" and "improving the slaughter practices".

First, the data were analysed through descriptive analysis in order to find similarities and differences between future professionals in the livestock sector of the two countries (Argentina and Italy). Bivariate analyses were then carried out to find relationships between pairs of variables and determine the statistical significance of the possible differences observed [27]). Different chi^2 analyses were performed, for the crossing of two categorical variables, one of them always being the country of the students surveyed.

The results are presented following the structure of the survey in its thematic sections: 1. demographic and personal characterisation; 2. perception and knowledge of sustainability and its dimensions; 3. perception of the sustainability of animal source foods.

The evaluation scale used in most of the questions was 11 points (from 0 to 10), where 0 was the lowest score (e.g., not at all important/not at all concerned) and 10 was the highest (definitely important/extremely concerned). For a better understanding of the data, the results are expressed with scores grouped into three levels of importance, as follows: from 0 to 3 little or not important at all; from 4 to 6 moderately important; and from 7 to 10 very or totally important. Categorical scales were used for the remaining questions.

3. Results

3.1. Demographic and Personal Characterisation

The comprehensive response rate was 27.3% (24.5% in Argentina and 31.6% in Italy). The sample consisted of 590 university students (321 Argentine and 269 Italian) attending courses related to animal production. In the Argentine sample, 60.1% were female, while in the Italian sample, almost 82.5% were female. In addition, both populations were characterised according to age into three groups and according to whether they were working or not (see Table 1).

Table 1. Sample characteristics.

Students	**Argentine *n* = 321**	**Italian *n* = 269**
Gender (%)		
Female	60.1	82.5
Male	39.9	17.5
Age (%)		
18–27 years old	55.1	82.5
28–40 years old	31.5	15.6
41+ years old	14.3 ([1])	1.9
Workers (%)		
Yes	75.1	25.3
No	24.9	74.7

Note ([1]) The high % of people aged 41 years or more is related to the frequency with which the student population also works and takes a longer time to obtain a degree.

3.2. Perception and Knowledge of Sustainability and Its Dimensions

3.2.1. Perception of Sustainability and Its Dimensions

Respondents from both countries were asked to rate their concern for the sustainability of the planet (Figure 1): in both countries, almost all of the students expressed high concern (Argentine students 93.5% and Italian students 95.1%).

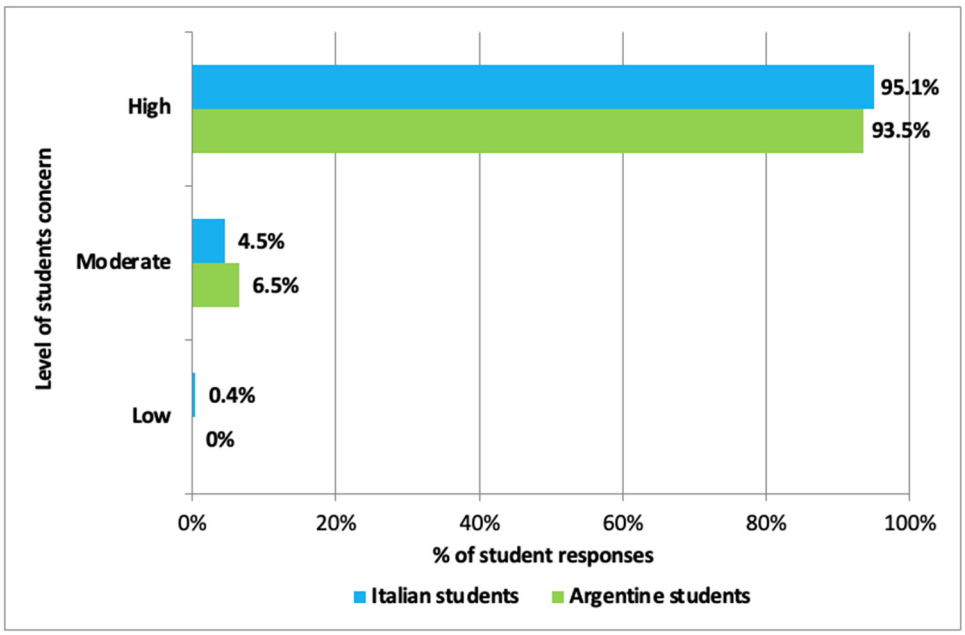

Figure 1. Level of concern for the sustainability of the planet.

No significant difference was found in the level of concern for the sustainability of the planet between the two groups of respondents ($p = 0.3055$); that is, concern did not vary with the country.

Subsequently, respondents were asked to write the first word that came to mind when they thought about sustainability. It turned out that the dimension most widely evoked by the students of both countries was the environment (67% Argentinians and 53% Italians), followed by a wide distance by the social and economic dimensions. The above-mentioned order was the same in both groups of respondents; however, significant differences were observed between Argentine and Italian students ($p = 0.0195$) (Figure 2).

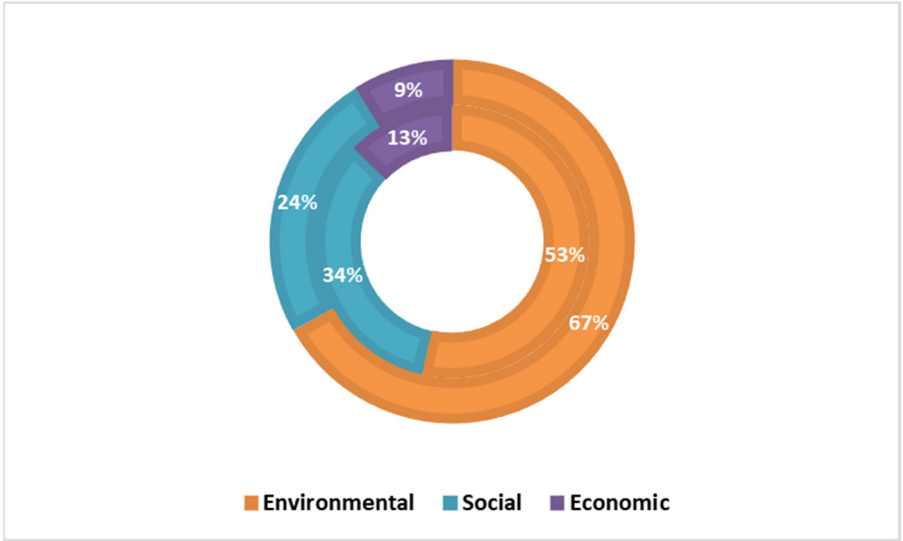

Figure 2. Percentage of words used by Argentine and Italian students, by dimensions.

Respondents were asked to assess the level of importance that they attributed to each of the 12 proposed statements (Table 2) related to sustainability, four for each dimension (environment, economic and social).

Table 2. Assessment of the degree of importance attributed to each statement related to sustainability.

Theme		Statements	Students	Mean	Score Value Attributed by Students (%)			*p*-Value
					Little or Not at All Important	Intermediate Importance	Very or Definitely Important	
Social Dimension	1.	Allows social development and roots in the local territory	Argentine Italian	8.23 8.08	3.1 3.3	15.0 10.8	81.9 85.9	$p = 0.3249$
	2.	Respects the human rights of producers and workers	Argentine Italian	7.76 8.00	6.5 7.4	20.6 13.0	72.9 79.6	$p = 0.0525$
	3.	Protects the public health of people	Argentine Italian	8.56 8.90	2.2 0.7	12.1 5.2	85.7 94.1	$p = 0.0041$
	4.	Requires more training and work to reduce the human impact on the environment	Argentine Italian	9.07 9.27	3.1 0.7	3.1 4.8	93.8 94.4	$p = 0.0757$
Environmental Dimension	5.	Balances the development of humanity and care for the environment	Argentine Italian	9.32 9.40	0.31 0.0	4.36 0.7	95.3 99.3	$p = 0.2433$
	6.	Maintains natural resources over time, for present and future generations	Argentine Italian	9.35 9.48	1.2 0.0	4.4 0.8	94.4 99.2	$p = 0.0171$
	7.	Adopts low-polluting production processes (e.g., less use of chemicals)	Argentine Italian	8.93 8.90	1.6 3.0	4.7 6.3	93.8 90.7	$p = 0.0046$
	8.	Favours biodiversity and reduces environmental risks (e.g., erosion, floods, fires, etc.)	Argentine Italian	9.23 8.96	0.6 0.4	3.7 7.8	95.6 91.8	$p = 0.3307$
Economic Dimension	9.	Is easier to implement on small production scales (e.g., family farming)	Argentine Italian	8.02 7.86	4.3 4.5	18.1 18.6	77.6 77.0	$p = 0.0935$
	10.	Requires more labour than traditional agriculture	Argentine Italian	7.21 7.59	10.3 5.2	22.4 21.2	67.3 73.6	$p = 0.2807$
	11.	Is a profitable activity that creates jobs	Argentine Italian	8.64 8.26	0.9 0.7	8.7 14.5	90.3 84.8	$p = 0.9841$
	12.	Strives to reduce losses to make more efficient use of resources	Argentine Italian	8.37 8.96	2.8 0.0	11.5 5.6	85.7 94.4	$p = 0.0588$

The participants from both countries attributed a high level of importance to all statements, with means greater than 7.21.

There were statistically significant differences in the assessment of social statement 3 ($p = 0.041$) and in two statements (6 and 7) concerning the environmental dimension ($p = 0.0171$ and $p = 0.0046$, respectively). In the survey conducted in Italy, more than 90% of respondents ranked the importance of the following assertions: statements 5, 6, 7 and 8 (all related to the environment), statements 3 and 4 (all related to social dimension), and only one statement (relating to economic dimension) (statement 12). More than 90% of the Argentine respondents also agreed that six statements were very significant. They agreed with the Italian students in four environmental statement evaluations (statements 5, 6, 7, and 8) and one social dimension. An analysis of the perception of the four statements of each dimension as a whole made it evident that the respondents from the two countries coincided in the order of importance they attributed to the three dimensions.

The assessment of the environmental dimension was the highest (average of 9.20 among Argentinians and 9.18 among Italians), followed by the social (average 8.41 among Argentinians and 8.56 among Italians) and the economic (with the lowest average, 8.06 among Argentinians and 8.17 among Italians) dimensions (Table 3).

No statistically significant difference ($p > 0.05$) was found between students from the two countries in the assessment of each dimension.

Table 3. Level of importance by dimension.

Dimension	Average of Each Dimension (from the Sum of the 4 Statements)		*p*-Value
	Argentine Students	Italian Students	
Environmental	9.20	9.18	$p = 0.2807$
Social	8.41	8.56	$p = 0.2433$
Economic	8.06	8.17	$p = 0.2871$

3.2.2. Knowledge of Sustainability and Its Dimensions

From the set of dimensions listed, the environmental dimension turned out to be the most widely identified (96.9% among Argentine respondents and 99.3% among Italian respondents), followed by the economic one (80.4% among Argentine respondents and 78.5% among Italian respondents) and the social one (78.8% among Argentine respondents and 72.9% among Italian respondents). A statistically significant difference was found in the identification of the environmental dimension, with the Italian students recognising this dimension to a greater extent than the Argentinians ($p = 0.0421$). In contrast, no statistically significant differences were observed between the two countries in the recognition of the social ($p = 0.0912$) and economic ($p = 0.6384$) dimensions (Table 4).

Table 4. Percentage of students who identified the different dimensions of sustainability.

Dimension	Students (%)		*p*-Value
	Argentine	Italian	
Environmental Dimension	96.9	99.3	$p = 0.0421$
Economic Dimension	80.4	78.5	$p = 0.6384$
Social Dimension	78.8	72.9	$p = 0.0912$
Three dimensions	9.4	13.4	$p = 0.1213$

The set of three dimensions was simultaneously identified by 9.4% of the Argentine respondents and by 13.4% of the Italian respondents (Table 4), with no statistically significant differences ($p = 0.1213$) in the knowledge of the three dimensions evaluated simultaneously by the future professionals surveyed.

Most students in both groups expressed only moderate agreement with the statement that sustainability is an easy concept to understand. On the other hand, the two groups of future professionals indicated that they fully agreed that the concern for sustainability has the potential to cause changes in the production system. There were no statistically significant differences between the two countries in either of these statements (Table 5).

Table 5. Level of agreement with the statements about sustainability.

Statements	Students	Mean	Score Values Attributed by Students (%)			*p*-Value
			Totally Disagree or Agree Little	Moderately Agree	Strongly or Totally Agree	
The concept of sustainability is easy to understand	Argentine	5.52	19.9	44.3	35.8	$p = 0.1461$
	Italian	5.21	22.7	49.0	28.3	
The concern for sustainability has the potential to cause changes in the production system	Argentine	6.52	14.3	29.3	56.4	$p = 0.1692$
	Italian	6.41	11.9	36.4	51.7	

The surveyed students reported using different sources of information (Figure 3). The main source for both groups was found to be Internet search engines, with a slight difference between Italian (80.7%) and Argentine (70.7%) students. Italian students also mentioned that their second source of information was social networks (55.4%), while Argentine students reported using specific books/papers (52.6%).

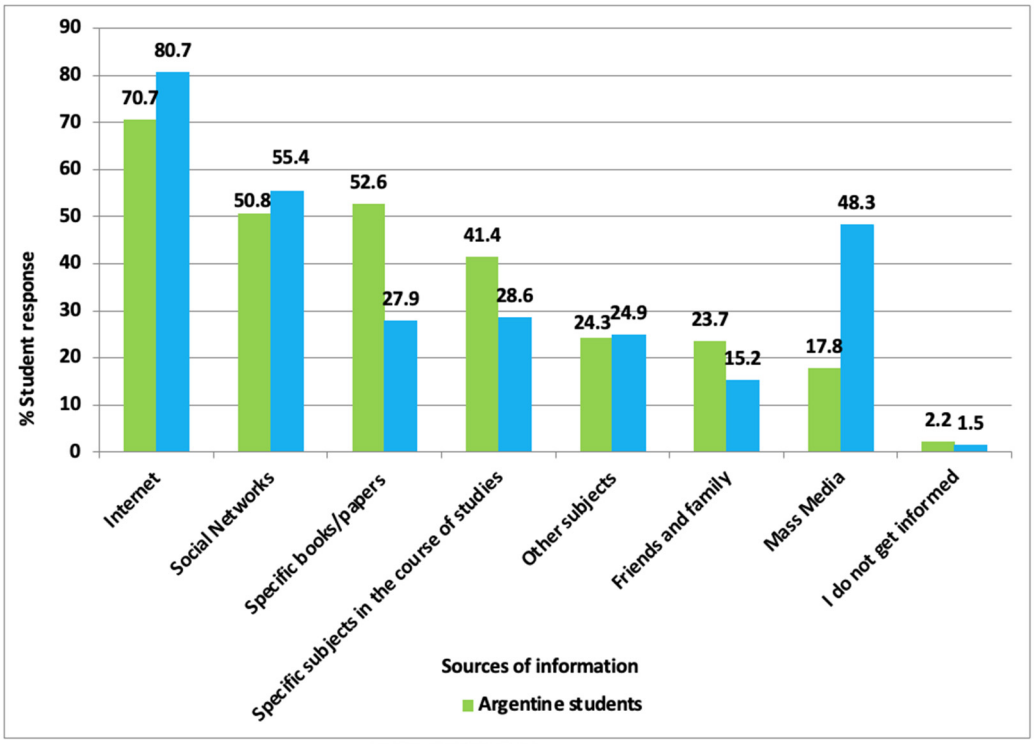

Figure 3. Sources of information used by Argentine and Italian students.

It was found that 51.7% of Argentine students evaluated their knowledge as good, followed closely by 43.6% those who considered their knowledge to be moderate and 4.7% poor. Among Italian students, 40.5% evaluated their knowledge as good, 48.3% as moderate and 11.2% as poor (Figure 4).

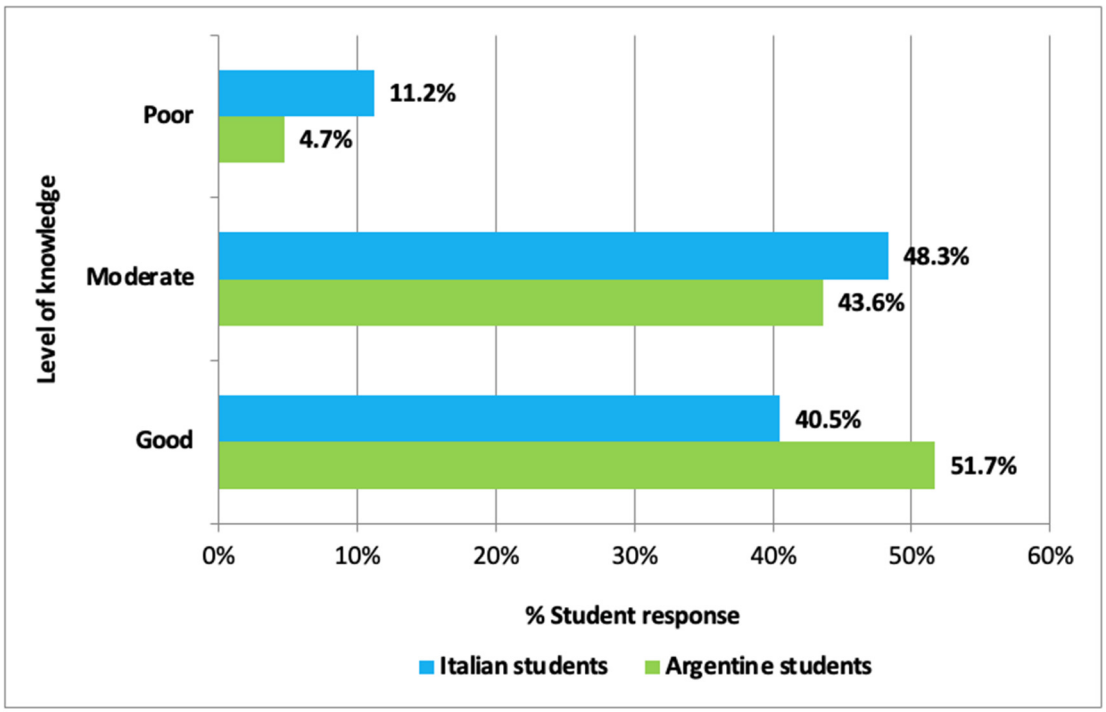

Figure 4. Assessment of the students' level of knowledge about sustainability.

3.3. Perception of the Level of Sustainability of Animal Source Foods

3.3.1. Perception of the Level of Sustainability of Food Production in Different Countries

Respondents were asked to rate their perceptions of the sustainability of food production in different countries. The countries assessed were those of the respondents (Argentina and Italy) and three major world producers of food raw materials, namely Brazil, the United States and China (Table 6). It was assumed that the interviewees had knowledge only of the production systems of their own countries. For this reason, we asked for Argentina and Italy, despite the fact that the latter is part of the European Union, while the assessments of the countries excluding their own were only their perceptions.

Table 6. The perceived sustainability of food production in different countries (%).

Country	Students	Perceived Sustainability		
		Low	Intermediate	High
Argentina	Argentine	29.7	54.4	15.9
	Italian	52.4	36.4	11.2
Brazil	Argentine	39.0	49.7	11.3
	Italian	57.2	31.6	11.2
China	Argentine	54.1	28.2	17.7
	Italian	64.3	24.9	10.8
United States	Argentine	39.7	40.5	19.8
	Italian	41.3	49.4	9.3
European Union	Argentine	8.8	28.1	63.1
	Italian	7.1	42	50.9
Italy	Argentine	8.7	28.5	62.8
	Italian	9.3	49.8	40.9

The perceived level of sustainability for food production was relatively positive for the EU, with the highest assessment by the two groups of students (very or totally sustainable: 63.1% among Argentine respondents and 50.9% among Italian respondents), with significant differences ($p = 0.0018$). China turned out to be the country with the lowest or most negative assessment, with 54.1% of Argentine and 64.3% of Italian respondents considering Chinese food production to have a low level of sustainability, with a statistically significant difference between the groups ($p = 0.0243$). Argentine students attributed a moderate level of sustainability to their home country, while Italian respondents perceived low or no sustainability in Argentina, with statistically significant differences ($p < 0.0001$). Finally, Italian production was perceived as being moderately sustainable (49.8%) by the Italian students, but as having a lower level of sustainability than the set of European countries. Argentine students evaluated the level of sustainability of Italian production as high, perfectly in line with European production.

3.3.2. Perception of the Level of Sustainability of Livestock Production

To analyse the perception of the sustainability of foods of animal origin, respondents were asked to rate the production of beef cows, dairy cows, chickens and pigs. For all categories, the options of confined rearing (intensive management systems, cages or sheds) and free-range rearing were presented, except for dairy cows because in Argentina only the field production system can be evaluated due to its great preponderance. The results obtained are presented below (Table 7).

Table 7. Assessment of sustainability in livestock production chains.

Production System	Students	Perceived Sustainability		
		Low	Intermediate	High
Cows raised in pasture-based management systems	Argentine	21.5	35.5	43.0
	Italian	19	34.5	46.5
Cows in intensive management systems	Argentine	54.8	31.2	14.0
	Italian	48	35.7	16.3
Dairy cows	Argentine	25.9	39.9	34.3
	Italian	16.0	30.1	53.9
Free-range chicken	Argentine	15.6	31.8	52.6
	Italian	15.2	28.3	56.5
Chicken raised in barn	Argentine	50.2	34.0	15.9
	Italian	56.9	29.7	13.4
Pigs raised in pasture-based management systems	Argentine	16.2	38.3	45.5
	Italian	20.1	46.1	33.8
Pigs raised in barn	Argentine	55.8	33.0	11.2
	Italian	56.5	31.2	12.3

Production characterised by animal confinement or intensive methods in cow, chicken and pig rearing were perceived as having low sustainability by students of both countries (more than 48% of those surveyed on the production of the three farm animals); no statistically significant differences were found ($p > 0.05$) between the assessments of the students surveyed (confined meat cows $p = 0.2498$; confined chicken $p = 0.2622$; and confined pig $p = 0.8601$).

On the contrary, high sustainability assessment was observed in the field production systems of chickens and beef cows. In both countries, the level of sustainability of chicken production was rated as high by 52.5% and 56.5% of the students surveyed from Argentina and Italy, respectively, and that of beef cow production was rated as high by 43% and 46.5%, with no significant difference in either of the two productions (in chickens $p = 0.6026$ and in beef cows $p = 0.6368$). On the other hand, differences were observed in the evaluation of the production of pigs raised in pasture-based management systems, where the Argentine respondents valued it as highly sustainable, as with the other field production systems, while the Italian students valued it as moderately sustainable, with significant differences between the two ($p = 0.0159$).

In the case of dairy cows, only field production in Argentina was evaluated, because it is the main production system in this country, while free stabling was evaluated for Italy. The Argentine respondents (39.9%) rated the production of dairy cows in Argentina as moderately sustainable, whereas Italian students (53.9%) rated their country's system as highly sustainable, with significant differences between Argentine and Italian students ($p < 0.0001$).

3.3.3. The Production of Animal Source Foods and Potential for Improvement

Respondents were asked to indicate what productive aspects could be modified in the future to improve sustainability or its perception in the different production systems proposed (Table 8).

The aspect to be improved that most students selected was eliminating the excessive use of medication/antibiotics in both countries (Argentine students 20.9% and Italian students 21.9%). For the Argentine students, other productive factors to be improved were the quality of the food given to the animals (20.5%) and the breeding environment of the animals (20.2%). For the Italian students, the quality of the food given to the animals did not seem to be a priority point of improvement since it obtained a relatively low percentage

of responses (12.0%). Italians perceived the breeding environment of animals (21.8%) and the treatment of animals throughout the life cycle (21.6%) as aspects to be improved.

Table 8. Contingency table of livestock production systems and their potential improvement points (%).

Production	Student	Quality of the Food Given to the Animals	Eliminating the Excessive Use of Medication/Antibiotics	Breeding Environment of the Animals	Treatment of Animals Throughout the Life Cycle	Improving the Slaughter Practices	Did Not Answer
Cows raised in pasture-based management systems	Argentine	44.2	42.7	41.1	45.2	45.2	9.0
	Italian	24.5	52.8	31.6	43.1	50.9	8.9
Cows in intensive management systems	Argentine	55.1	57.0	65.1	52.0	43.0	8.7
	Italian	41.3	61.7	78.8	66.2	55.0	2.2
Dairy cows ([1])	Argentine	48.0	54.5	46.7	46.4	26.8	10.9
	Italian	23.8	53.2	29.4	45.4	35.3	8.9
Free-range chicken	Argentine	42.7	40.8	34.9	34.0	36.1	15.9
	Italian	19.7	32.7	34.6	39.4	40.1	18.2
Chicken raised in barn	Argentine	56.1	64.5	59.8	49.2	37.4	8.7
	Italian	33.5	63.9	77.3	63.6	51.3	3.0
Pigs raised in pasture-based management systems	Argentine	47.4	40.2	38.9	34.3	39.9	13.4
	Italian	26.8	48.7	40.5	43.1	43.5	13.0
Pigs raised in barn	Argentine	59.8	62.0	62.0	53.9	45.2	10.0
	Italian	34.2	60.2	78.4	67.7	52.0	3.0
Total (%)	Argentine	20.5	20.9	20.2	18.2	15.8	4.4
	Italian	12	21.9	21.8	21.6	19.3	3.4
Ranking potential improvement	Argentine	2	1	3	4	5	6
	Italian	5	1	2	3	4	6

Note ([1]) In the case of dairy cows, only field production in Argentina was evaluated, because it is the main production system in this country, while free stabling was evaluated for Italy.

Concerning the need for productivity improvements of the species raised, by type of production, the students from both countries considered the confined or intensive systems as those requiring the greatest improvement, though in different orders. Among Argentine students, the first production to be improved was that of pigs (16.9%), followed by beef cows (16.3%) and chickens (15.9%). On the other hand, among Italian students, the first production to be improved was that of beef cows (17.9%), followed by pigs (17.4%) and chickens (17.2%). In both countries, necessary improvements were also considered for extensive production, but at lower percentages (Table 8).

Concerning the production by species, there were significant differences in the evaluation of beef cows in pasture-based management systems. The demand for improvements perceived by Argentine students was greater than that perceived by Italian students in feed quality ($p < 0.0001$) and breeding environment ($p = 0.169$). On the other hand, a greater need for improvement was perceived by Italian students in the excessive use of medication/antibiotics with a significant difference ($p = 0.0143$). In the remaining possible improvements analysed, there were differences in the evaluations, but they were not statistically significant.

In stabled beef cows, statistically significant differences were revealed in different parameters. The assessment assigned to feed quality showed a greater need for improvement in Argentina ($p = 0.0008$), and there was a greater need for improvement in Italy for the breeding environment ($p = 0.0002$), the treatment of animals throughout the life cycle ($p = 0.0005$) and improving the slaughter practices ($p = 0.0036$).

In confined chickens, the greatest point of improvement in Argentina was the excessive use of medication/antibiotics, followed by the breeding environment, while in Italy the opposite order was observed. No statistically significant difference was found for the evaluations on the use of medication/antibiotics ($p = 0.8905$), but a statistically significant difference was found in the evaluation of breeding environment ($p < 0.0001$). In free-range chickens, statistically significant differences were found in the evaluations of feed quality

(p = 0.0001) with a need for improvement mostly perceived in Argentina, followed by excessive use of medication/antibiotics (p = 0.0001), with a greater need for improvement perceived by Italian respondents.

In pigs in confined systems, there were significant differences in the need for improvement in feed quality ($p < 0.0001$), with a higher need reported by Argentine students in the breeding environment ($p < 0.0001$) and in the treatment of animals throughout the life cycle (p = 0.0007), with demands for greater improvement by Italian students. In the field production system, a greater need for improvement in feed quality was assigned by Argentine students, with a significant difference with respect to the improvement indicated by the Italians ($p < 0.0001$).

For free-range dairy cows, the aspect perceived as most in need of improvement in both countries was the excessive use of medication/antibiotics, without statistically significant differences (p = 0.7419). The second aspect for the Argentine students was the feed quality, with statistically significant differences from the evaluation given by the Italian students ($p < 0.0001$), while the second aspect rated by the Italian students was the treatment of animals throughout the life cycle, with a statistically significant difference from the evaluation of the Argentine students ($p < 0.0001$).

Finally, the questionnaire inquired about the importance of sustainability for their professional future in the livestock sector. Respondents from both countries valued this topic as highly or totally important (94.5% Argentine and 88.1% Italian students) (Figure 5), with a statistically significant difference (p = 0.0361).

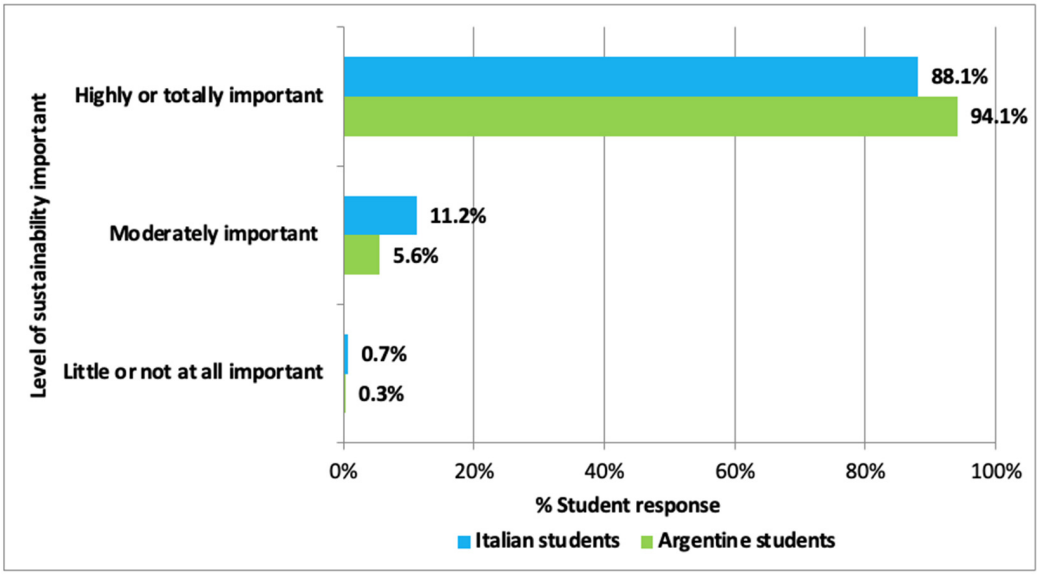

Figure 5. Importance of sustainability for the students' future work (%).

4. Discussion

The results of this work confirm that there is a high level of concern in relation to the sustainability of the planet. The concern is not only at the level of society, as demonstrated by the movements against climate change (Fridays for Future [28]; Rise for Climate [29]; Y20 [30]), but also at the level of the scientific community and, in this case, represented by future professionals in the primary sector, without distinction between the two countries studied and the different academic training of the students surveyed.

The concept of sustainability is highly linked to the environmental dimension. The participants thought of sustainability mainly in terms of environmental sustainability and only at lower percentages in terms of economic and social sustainability, in both countries. These findings are consistent with the literature, which indicates that people and students attending different courses mainly evoke the environmental dimension [31–35]. Although the environmental component arose spontaneously more frequently, the respon-

dents attributed high importance to all the proposed statements related to sustainability. It should be noted that environmental statements yielded higher scores in both groups of respondents, again positioning the environmental dimension first, followed by the social and economic dimensions. Future Italian professionals recognise sustainability's ability to protect the public health of citizens; however, it was the future Argentine professionals who indicated a stronger relationship between sustainable production and the lower use of chemical pollutants. This result is unique and deserves to be investigated to understand why the health of citizens and sustainability involving a lower use of chemical pollutants are not perceived as related.

Only 9.4% of the Argentine and 13.4% of the Italian respondents simultaneously identified the three dimensions of sustainability; nevertheless, they attributed a high level of importance to all the statements related to the three dimensions. It is possible that the level of importance attributed derives from an analytical and critical ability to identify the relationship between the concepts contained in the statements and sustainability, but without real theoretical knowledge of it, as evidenced by other authors [31,32,36,37]).

This analysis would also justify the declared difficulty in understanding the concept of sustainability, which should draw attention to the sources used for information. Although important and valid information can be found on the web, it can be difficult to navigate and select that with scientific value [38–41]. It would be desirable for future professionals such as those surveyed in this study to be trained mainly in specific courses and texts, and only subsequently use the web.

The training of future professionals involved in food production is a key aspect that will help the sector to face the challenges involved in food production. As with their future colleagues from other countries [31,42], both groups of students understood the importance of sustainability in their future work since almost all the respondents declared that this topic will be highly important to their future employment. Most of the respondents also indicated that the concern for sustainability has the potential to cause changes in the production system and perceived the production systems in their countries as moderately sustainable.

Concerning the level of sustainability perceived by type of livestock production, it can be noted that extensive production was considered to be mostly sustainable, a result in accordance with the principle of organic production (Regulation EU 2018/848 [43]) but in disagreement with the literature that analyses the impact on the environment using the life cycle assessment (LCA) methodology, which indicates how more efficient productions are less impactful per unit of product [8,44].

According to the perception of future professionals, intensive production must improve in the use of antibiotics, perceived as high both among Argentine and Italian students. In addition, they perceived some points related to the ethical components of production systems as requiring improvement. In Argentina, the productive environment and the quality of animal feed, particularly for pigs, are critical elements. This result is in line with the findings in the literature [45–47], which indicate that in the perception of the Argentine population, pigs are fed poor-quality products. For Italians, on the other hand, the factors to be improved are the productive environment and the treatment of the animals throughout the life cycle, particularly for beef cows.

5. Conclusions

The issue of sustainability is broad and complex and can be approached from different points of view, including the perspective of an extensive approach, in line with the indications of the European Green Deal and policies in favour of a diet change, or from a sustainable intensification approach, as a principle at the base of the LCA studies. All strategies may be appropriate to meet different demands according to their characteristics, or they can give rise to new strategies through the synergy of production methodologies. However, they must all maintain the same objective, to meet the needs of the three components of sustainability. For this reason, it is necessary for academic training to be broad, articulated, deep and up to date, so that future professionals can autonomously

identify the most suitable instruments to respond to the various demands that arise in the productive reality. The results of this study indicate that the knowledge of the sustainability of the students, of all the careers evaluated and in the two countries under analysis, is partial. Either spontaneously or induced and regardless of the chosen career, the majority of students associate sustainability with the environmental dimension, relegating the social and economic dimensions to collateral dimensions. It is necessary to reflect on the level and quality of academic training, including careers oriented towards productions of animal origin, and think about educational proposals that include the three dimensions in a more inclusive way, or with a systemic character of interrelationships and multidisciplinary way, for the benefit of a more complete training and oriented to the future productive challenges. Therefore, universities surveyed must continue acting to improve the knowledge of their apprentices, whether by providing specific courses, expanding the subject contents or helping students to use the web correctly to enjoy all its advantages, since sustainability is increasingly important for the future employment of professionals who graduate from technical-scientists subjects. Students currently seem to be predominantly focused on the environmental component of sustainability and on the extensive approach, which may not always be the best response in all situations, especially in a world where the population is estimated to continue to increase. Since this work represents a case study, in which the respondents are Italian and Argentinean students, the results cannot be generalised to global consumption dynamics. In the future, it will be increasingly important to analyse the perspectives of the various actors involved in the productive sector, to encourage joint strategies and identify the points at which it is necessary to intervene with knowledge and information systems. Future research may focus on the reasons why the social and economic dimensions are not reflected in the minds of future professionals. Training will play an essential role in rebalancing the importance attributed to the three fundamental components of sustainability.

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References

1. UN—United Nations. Secretary-General; World Commission on Environment and Development. In *Report of the World Commission on Environment and Development: Our Common Future, Brundtland Report*; United Nations Digital Library: New York, NY, USA, 1987. Available online: https://digitallibrary.un.org/record/139811?ln=es (accessed on 25 May 2022).
2. UN—United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*; Res AUnit/RES/70/1; Department of Economic and Social Affairs, United Nations: New York, NY, USA, 2015. Available online: https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981 (accessed on 25 May 2022).

3. Thornton, P.K. Livestock production: Recent trends, future prospects. *Philos. Trans. R. Soc. B Biol. Sci.* **2010**, *365*, 2853–2867. [CrossRef]
4. Godfray, H.C.J.; Beddington, J.R.; Crute, I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Pretty, J.; Robinson, S.; Thomas, S.M.; Toulmin, C. Food security: The challenge of feeding 9 billion people. *Science* **2010**, *327*, 812–818. [CrossRef]
5. Sánchez-Sabate, R.; Sabaté, J. Consumer Attitudes Towards Environmental Concerns of Meat Consumption: A Systematic Review. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1220. [CrossRef]
6. Gerber, P.J.; Steinfeld, H.; Henderson, B.; Mottet, A.; Opio, C.; Dijkman, J.; Falcucci, A.; Tempio, G. *Enfrentando el Cambio Climático a Través de la Ganadería—Una Evaluación Global de las Emisiones y Oportunidades de Mitigación*; 2013 Edition Version; Organización de las Naciones Unidas para la Alimentación y la Agricultura (FAO): Roma, Italy, 2013. Available online: http://www.fao.org/3/i3437s/i3437s.pdf (accessed on 25 May 2022).
7. Herrero, M.; Wirsenius, S.; Henderson, B.; Rigolot, C.; Thornton, P.; Havlik, P.; De Boer, I.J.; Gerber, P. Livestock and the Environment: What Have We Learned in the Past Decade? *Annu. Rev. Environ. Resour.* **2015**, *40*, 177–202. [CrossRef]
8. De Vries, M.; De Boer, I.J. Comparing environmental impacts for livestock products: A review of life cycle assessments. *Livest. Sci.* **2010**, *128*, 1–11. [CrossRef]
9. Poore, J.; Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* **2018**, *360*, 987–992. [CrossRef]
10. Van Loo, E.J.; Caputo, V.; Nayga, R.M.; Verbeke, W. Consumers' Valuation of Sustainability Labels on Meat. *Food Policy* **2014**, *49*, 137–150. [CrossRef]
11. Eurobarometer. Special Eurobarometer 501, Attitudes of European Citizens towards the Environment. December 2019. 2020. Available online: https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/survey/getSurveydetail/instruments/special/surveyky/2257 (accessed on 15 September 2022).
12. Briggeman, B.C.; Lusk, J.L. Preferences for foirness and equity in the food system. *Eur. Rev. Agric. Eco.* **2011**, *38*, 1–29. [CrossRef]
13. Vermeir, I.; Verbeke, W. Sustainable Food Consumption: Exploring the Consumer. "Attitude—Behavioral Intention" Gap. *J. Agric. Environ. Ethics* **2006**, *19*, 169–194. [CrossRef]
14. Bollani, L.; Bonadonna, A.; Peira, G. The Millennials' Concept of Sustainability in the Food Sector. *Sustainability* **2019**, *11*, 2984. [CrossRef]
15. Grunert, K.G. Sustainability in the Food Sector: A Consumer Behaviour Perspective. *Int. J. Food Syst. Dyn. Int. Cent. Manag. Commun. Res.* **2011**, *2*, 207–218. [CrossRef]
16. Bifaretti, A. Inteligencia Competitiva en la Cadena Argentina de Ganados y Carnes. 2005. Available online: http://www.ipcva.com.ar/vertext.php?id=268 (accessed on 25 July 2021).
17. de Jonge, J.; van Trijp, H.C. Meeting heterogeneity in consumer demand for animal welfare: A reflection on existing knowledge and implications for the meat sector. *J. Agric. Environ. Ethics* **2013**, *26*, 629–661. [CrossRef]
18. Damico, A.B.; Aulicino, J.M.; Di Pasquale, J. What Does Sustainability Mean? Perceptions of Future Professionals across Disciplines. *Sustainability* **2022**, *14*, 9650. [CrossRef]
19. Oguz, D.; Çakci, I.; Kavas, S. Environmental awareness of university students in Ankara, Turkey. *Afr. J. Agric. Res.* **2010**, *5*, 2629–2636.
20. Lozano, R.; Lukman, R.; Lozano, F.J.; Huisingh, D.; Lambrechts, W. Declarations for Sustainability in Higher Education: Becoming Better Leaders, through Addressing the University System. *J. Clean. Prod.* **2013**, *48*, 10–19. [CrossRef]
21. Waas, T.; Verbruggen, A.; Wright, T. University research for sustainable development: Definition and characteristics explored. *J. Clean. Prod.* **2010**, *18*, 629–636.
22. FAOSTAT. 2019. Available online: http://www.fao.org/faostat/en/#home (accessed on 25 August 2019).
23. Eurostat. 2020. Available online: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220222-1 (accessed on 15 September 2021).
24. EU. 2019. Available online: https://www.switchtogreen.eu/the-eu-green-deal-promoting-a-green-notable-circular-economy/#:~{}:text=The%20European%20Green%20Deal%20aims,a%20just%20and%20inclusive%20transition (accessed on 21 September 2022).
25. Grande Esteban, I.; Abascal Fernández, E. *Fundamentos y Técnicas de Investigación Comercial*; Ed. ESIC: Madrid, España, 2007.
26. Di Rienzo, J.A.; Casanoves, F.; Balzarini, M.G.; Gonzalez, L.; Tablada, M.; Robledo, C.W. InfoStat Versión 2020. Centro de Transferencia InfoStat, FCA, Universidad Nacional de Córdoba, Argentina. Available online: http://www.infostat.com.ar (accessed on 30 November 2020).
27. Pedret, R.; Sagnier, L.; Camp, F. *Herramientas para Segmentar Mercados y Posicionar Productos. Análisis de Información Cuantitativa en Investigación Comercial*; Ed. Deusto: Barcelona, España, 2000.
28. Fridays for Future Movement. Available online: https://fridaysforfuture.org/ (accessed on 25 July 2022).
29. Rise for Climate Demonstration. Available online: https://riseforclimate.org/ (accessed on 25 July 2022).
30. Y20—Youth 20 Italy. Available online: http://www.youngambassadorssociety.it/y20italy.html (accessed on 25 July 2022).
31. Burkhart, S.; Verdonck, M.; Ashford, T.; Maher, J. Sustainability: Nutrition and Dietetic Students' Perceptions. *Sustainability* **2020**, *12*, 1072. [CrossRef]
32. Kagawa, F. Dissonance in Students' Perceptions of Sustainable Development and Sustainability. *Int. J. Sustain. High. Educ.* **2007**, *8*, 317–338. [CrossRef]
33. Atkinson, G. Measuring corporate sustainability. *J. Environ. Plan. Manag.* **2000**, *43*, 235–252.

34. Reinhardt, F. Sustainability and the firm. *Sustain. Bus.* **2000**, *30*, 26–41.
35. Barth, M.; Timm, J.M. Higher Education for Sustainable Development: Students' Perspectives on an Innovative Approach to Educational Change. *J. Soc. Sci.* **2011**, *7*, 13–23. [CrossRef]
36. Msengi, I.; Doe, R.; Wilson, T.; Fowler, D.; Wigginton, C.; Olorunyomi, S.; Banks, I.; Morel, R. Assessment of Knowledge and Awareness of "Sustainability" Initiatives among College Students. *Renew. Energy Environ. Sustain.* **2019**, *4*, 6. [CrossRef]
37. Watson, M.K.; Lozano, R.; Noyes, C.; Rodgers, M. Assessing Curricula Contribution to Sustainability More Holistically: Experiences from the Integration of Curricula Assessment and Students' Perceptions at the Georgia Institute of Technology. *J. Clean. Prod.* **2013**, *61*, 106–116. [CrossRef]
38. Nazari, Z.; Oruji, M.; Jamali, H.R. News Consumption and Behavior of Young Adults and the Issue of Fake News. *J. Inf. Sci. Theory Pract.* **2022**, *10*, 1–16. [CrossRef]
39. Veeriah, J. Young adults' ability to detect fake news and their new media literacy level in the wake of the covid-19 pandemic. *J. Content Community Commun.* **2021**, *13*, 372–383. [CrossRef]
40. de Vicente Domínguez, A.M.; Beriain Bañares, A.; Sierra Sánchez, J. Young Spanish Adults and Disinformation: Do They Identify and Spread Fake News and Are They Literate in It? *Publications* **2021**, *9*, 2. [CrossRef]
41. Mason, L.; Boldrin, A.; Ariasi, N. Searching the Web to learn about a controversial topic: Are students epistemically active? *Instr. Sci.* **2010**, *38*, 607–633. [CrossRef]
42. Boarin, P.; Martinez-Molina, A.; Juan-Ferruses, I. Understanding Students' Perception of Sustainability in Architecture Education: A Comparison among Universities in Three Different Continents. *J. Clean. Prod.* **2020**, *248*, 119237. [CrossRef]
43. Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on Organic Production and Labelling of Organic Products and Repealing Council Regulation (EC) No. 834/2007. Available online: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32018R0848 (accessed on 12 April 2022).
44. McClelland, S.C.; Arndta, C.; Gordon, D.R.; Thoma, G. Type and number of environmental impact categories used in livestock life cycle assessment: A systematic review. *Livest. Sci.* **2018**, *209*, 39–45. [CrossRef]
45. Damico, A.B.; Aulicino, J.M.; Di Pasquale, J. Perceptions and Preconceptions about Chicken and Pork Meat: A Qualitative Exploratory Study of Argentine Consumers in the Metropolitan Area of Buenos Aires. *Sustainability* **2020**, *12*, 6729. [CrossRef]
46. Marotta, E. El cerdo en la cultura gastronómica. In Proceedings of the 1º Curso Producción de Carne Porcina y Alimentación Humana: Forum of Food, Nutrition and Health (Foro de la Alimentación, la Nutrición y la Salud—FANUS) y Bolsa de Cereales, Buenos Aires, Argentina, 4–5 November 2004. Available online: http://fanus.com.ar/eventos/produccion-porcina-alimentacion (accessed on 14 April 2020).
47. Institute for the Promotion of Argentine Beef (Instituto de Promoción de la Carne Vacuna Argentina—IPCVA)—TNS Gallup. *El Consumo de la Carne Vacuna en Argentina*; Documento de trabajo Nº 2; IPCVA: Buenos Aires, Argentina, 2005. Available online: http://www.ipcva.com.ar/files/libro_gallup.pdf (accessed on 11 April 2020).

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A Machine Learning Ensemble Approach for Predicting Factors Affecting STEM Students' Future Intention to Enroll in Chemistry-Related Courses

Ardvin Kester S. Ong

School of Industrial Engineering and Engineering Management, Mapúa University, 658 Muralla St., Intramuros, Manila 1002, Philippines; aksong@mapua.edu.ph; Tel.: +63-(2)8-247-5000 (ext. 6202)

Abstract: The need for chemistry-related professionals has been evident with the rise of global issues such as the pandemic and global warming. Studies have indicated how an increase in the amount of professionals should start within the classroom setting, enhancing the interest and motivation of students to pursue higher education in the related field. This study aimed to evaluate and predict factors affecting STEM students' future intention to enroll in chemistry-related courses. Through the use of machine learning algorithms such as a random forest classifier and an artificial neural network, a total of 40,782 datasets were analyzed. Results showed that attitude toward chemistry and perceived behavioral control represent the most influential factors, followed by autonomy and affective behavior. This demonstrated that students' interest, application in real life, and the development of knowledge and skills are key indicators that would lead to a positive future intention for pursuing the course in higher education. This is the first study that has analyzed students' future intentions using a machine learning algorithm ensemble. The methodology and results may be applied and extended among other human factor studies worldwide. Lastly, the presented discussion and analysis may be considered by other universities for their education strategies across different countries.

Keywords: chemistry; machine learning algorithm; random forest classifier; artificial neural network; STEM students; education

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1. Introduction

Chemistry-related courses correspond to the different aspects of applied, social, and life sciences. Graduating from the related courses would develop professionals in the field of medicine, research, academe, government, manufacturing, law, sales and marketing, production, and even business. Ong et al. [1] discussed how sub-disciplines such as analytical, physical, inorganic, biology, and organic chemistry are the five core learnings the students need in order to develop competence. To this end, professionals are needed in different fields [2]. Shwartz et al. [2] and Ong et al. [3] explained how there is a lack of professionals in the different fields of chemistry around the world. Ong et al. [3] explained that this is due to the challenge students perceive when they take on chemistry-related courses.

With the world facing different threats such as global warming and the COVID-19 pandemic, the need for chemistry-related professionals in the field of environmental sciences, medicine, and research is evident. Borges [4] expounded on the need for chemistry-related professionals in different fields. The same research also studied how the connection of a basic knowledge of chemistry in higher education, the development of skills, and support for knowledge are needed to advance the careers of professionals. Supporting this statement, an article from the Nature Editorial [5] stated that a green reset is needed. In accordance, Ong et al. [3] stated that these attributes should start in the classroom, setting up an environment to prepare students to take on the challenges and responsibilities globally. To which end, students should be equipped with the knowledge and skills for this to happen.

From the students' point of view, resistance to taking on the related courses is a challenge. This is why there is a lack of enrollees who consider chemistry-related courses. Previous studies have presented the non-retention and the choice of other educational fields despite the job demand available for chemistry-related professionals [6,7]. Garcia et al. [8] explained how other engineering courses and fields are more desired by STEM student graduates, since chemistry is perceived to be difficult. In response, Ong et al. [3] indicated that several factors, both cognitive and behavioral, should be explored to determine why students opt for other career paths with evident opportunities present.

In Mexico, Hofstein and Mamlok-Naaman [9] concentrated on behavioral factors such as the attitude of students in studying chemistry. However, the results presented how limited information is available to create a thorough discussion on what affects the behavior of students. In the United Kingdom, Burford et al. [10] focused on students choosing neurosurgery—one of the majors which requires several chemistry subjects. Having the option for work–life balance was the most influential factor for students to choose this career path. In Israel, Shwartz et al. [2] considered the behavioral, personal, and environmental factors affecting the career choices of chemistry-related professionals. The results showed that the students' intentions in choosing a career are developed inside the classroom. This was said to be present in how tasks and lectures are being developed. In addition, Ong et al. [3] also presented the same results among students in the Philippines. Their discussion highlighted how the available lessons, their delivery, and their application to real-life scenarios would encourage students to take chemistry-related courses. In addition, cultural differences can affect a student's behavioral and cognitive engagement [11]. Despite the available pieces of literature, the need for exploring behavioral aspects of students to close the gap of understanding why they would choose or avoid chemistry-related courses has been underexplored.

To measure the behavioral aspects of students, an integrated framework of self-determination theory (SDT) and theory of planned behavior (TPB) may be utilized. According to Bunce et al. [12] and Ryan and Deci [13], SDT is a theory usually considered for the education setting. This measures the competency, autonomy, and relatedness of students' motivation [14]. However, other behavioral aspects are not covered in SDT alone. The studies of Ong et al. [3] and Hollett et al. [15] considered integrating TPB to holistically measure the behavior and intentions of students. TPB is a framework used to measure the levels of control that behavior, attitude, and subjective norms of an individual alter their motivation or intention [16]. Guerin and Toland [17] explained how TPB is used in decision-making, covering beliefs from a behavioral perspective. Moreover, Lung-Guang [18] also discussed how these beliefs included either negative or positive engagement. Knauder and Koschmieder [19] then stated that factors such as affect and attitude could measure students' future intentions, in this case choosing chemistry-related courses.

The available studies have mostly utilized multivariate tools such as structural equation modeling (SEM) to measure human behavior [3,19]. Despite SEM being a powerful and reliable tool to determine the causal relationship among latent variables, several studies have criticized the methodology and explored its limitations. Woody [20] discussed how SEM calculates the significance based on the present relationship. Thus, it was explained how the mediating effects of factors may cause the significance level to be lower. Similarly, Fan et al. [21] also stated how the presence of mediators may have low to no significance if the independent variables are far from the dependent variable. To add to this, Duarte and Pinho [22] suggested combining SEM with other tools to validate its findings. Common trends in research nowadays utilize SEM with machine learning algorithms (MLA) such as a random forest classifier (RFC) and an artificial neural network (ANN) [23].

Ong et al. [24,25] considered the utilization of MLAs to evaluate human behavior in the adoption and actual use of technology. It was proven that RFC and ANN can predict factors affecting human behavior with high accuracy. In addition, the studies of Yuduang et al. [23] and Gumasing et al. [26] indicated that the nonlinear relationship of a framework utilized would be viable when analyzed using either ANN or RFC. However,

no studies have considered sole machine learning in assessing education-related studies. This study aimed to predict factors affecting senior high school STEM students' intention to enroll in chemistry-related courses utilizing MLAs such as RFC and ANN. Specifically, the main questions this research would want to assess are:

1. What is the most significant factor affecting students' future intentions to enroll in chemistry-related courses among the SDT and TPB latent variables?
2. Will the results of RFC and ANN be consistent with the behavioral analysis in the education setting?

The results of this study may pave the way for the holistic measurement of students' behavior towards their intention, which could be capitalized on by institutions in developing motivations for students. The framework utilized in this study could be applied and extended to measure students' future intentions to enroll in other fields of expertise. In addition, the methodology and results of this study may be considered to evaluate students' behavior in other academic settings worldwide.

2. Conceptual Framework

Presented in Figure 1 is the integrated framework utilized in this study. A total of seven hypotheses were created, with three coming from factors under SDT, autonomy, competency, and relatedness. Under TPB, attitude and perceived behavioral control were considered. In this study, the attitude was separated into two factors under attitude (attitude towards laboratory and attitude towards chemistry subjects) that may affect the affective latent variable. The dependent variable considered is the future intention to enroll in chemistry-related courses.

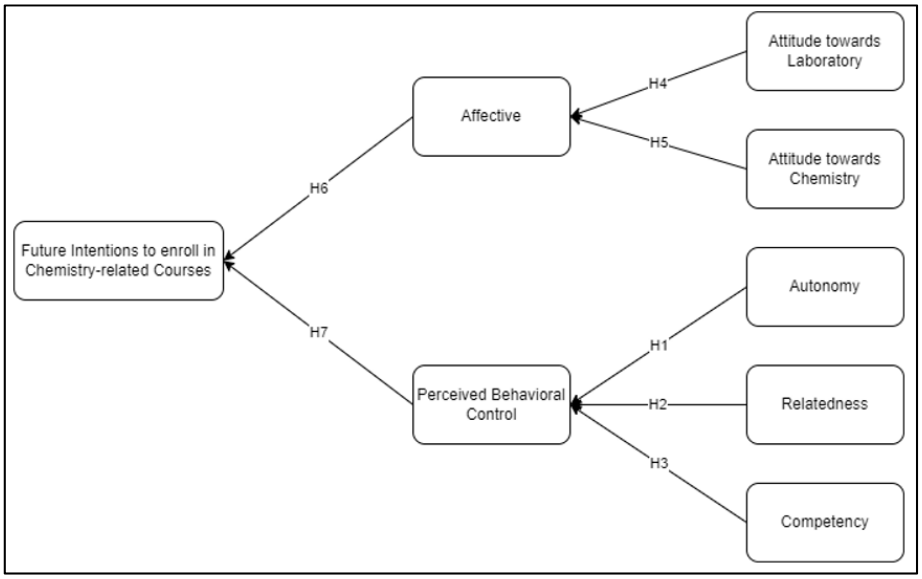

Figure 1. Conceptual framework to measure intention to enroll in chemistry-related courses.

Under SDT, three latent variables are considered following the creation of the theory [13]. Autonomy, relatedness, and competency have been evaluated to measure the behavioral aspects of an individual based on constructs that may be perceived as either negative or positive [3]. Firstly, Hiatt et al. [27] were able to discuss the relationship between autonomy on perceived behavioral control for students who have intentions to enroll for business administration as their form of higher education. Secondly, relatedness is the factor associated with TPB's subjective norm [3], which was disregarded in the educational setting in the early years [28]. However, this factor was seen to be a significant and contributing latent variable that may affect the decision of an individual in the education setting. Lastly, competency is the knowledge and skill required to perform an act without the need for a

reward [28]. Students would consider their level of competence to know which intention they would pursue based on their intellectual abilities [29]. It was presented in several studies [3,27–29] how these three latent variables affect the perceived behavioral control that will measure their future intentions either negatively or positively. Thus, the following were hypothesized:

H1. *Autonomy would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses through perceived behavioral control.*

H2. *Relatedness would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses through perceived behavioral control.*

H3. *Competency would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses through perceived behavioral control.*

Attitude may be the negative or positive belief among students about their motivation and intention [18]. In this case, both the attitudes toward the subject and its application in laboratory classes were considered. In chemistry, the theoretical and conceptual aspects are taught in class, while its application is demonstrated in the laboratory [9]. Both the different fields of attitude for students affect their affective behavior, which may have an indirect effect on their future intentions [3]. To engage the measurement of both conceptual and actual applications, it was hypothesized that:

H4. *Attitude towards laboratory would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses through the affective variable.*

H5. *Attitude towards chemistry would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses through the affective variable.*

Affective behavior directly affects an individual's intention, which covers the emotional aspects [30]. The emotional aspect may be affected by the demonstrated attitude of the students and is one of the most important aspects for studying science-related courses [31]. Dicker et al. [32] also highlighted how the affective behavior influenced by students' attitudes would permit a negative or positive effect on their achievements. Several studies by Nwagbo [33] and al Hadid et al. [34] support how affective behavior affects the future intentions of students when dealing with chemistry-related courses. Therefore, it was hypothesized that:

H6. *Affective would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses.*

Perceived behavioral control (PBC) is a person's ability to decide how to act on a matter, either negatively or positively, based on their level of control [35]. Akçayir et al. [31] explored the positive control in behavior among students. It was seen that PBC has a directly proportional effect on future intentions among students upon learning a subject matter. Several studies in an education setting [6,36,37] have proven and justified the effect of PBC on future intentions for career paths, goals, and choices. Thus, it was hypothesized that:

H7. *Perceived behavioral control would be the most significant factor affecting students' future intentions to enroll in chemistry-related courses.*

3. Methodology

3.1. Demographics

The descriptive statistics of the respondents are presented in Table 1. A total of 971 valid responses were collected via convenience sampling during April–June 2022. An online questionnaire adopted from the study of Ong et al. [3] was utilized to evaluate students' future intention to enroll in chemistry-related courses. Only those enrolled in senior high school were considered in this study. The online survey was distributed via Google Forms

to different social media platforms to reach senior high school respondents due to the strict COVID-19 protocols and full online learning. Utilizing a 5-point Likert Scale similar to Ong et al. [3], the survey complied with the Data Privacy Act (Republic Act No. 10173) of the Philippines, wherein respondents were asked to fill out and sign a consent form that was approved by the Mapua University Research Ethics Committees (Document No.: FM-RC-22-20). A check box for conformity was obtained from each respondent prior to answering the survey form stating that all information and data obtained would be strictly used for academic research purposes. Upon agreement, respondents would proceed with the survey questionnaire, and those who do not agree would not proceed to answer the survey.

Table 1. Descriptive statistics of respondents (n = 971).

Characteristics	Category	N	%
Age	15	7	0.720
	16	174	17.92
	17	436	44.90
	18	331	34.09
	19	23	2.370
Gender	Male	568	58.50
	Female	401	41.30
	Others	2	0.200
Allowance (in Philippine Peso, PhP)	1000 and below	596	61.38
	Above 1000 and 3000	325	33.47
	Above 3000 and 5000	35	3.600
	Above 5000 and 7000	10	1.030
	Above 7000	5	0.520
Relatives are taking up/took up chemistry-related courses	Yes	164	16.89
	No	807	83.11

From the data gathered, the majority of the respondents were 17 years old (44.9%), 18 years old (34.1%), and 16 years old (17.9%) and were either male (58.5%) or female (41.3%). Following the study of Ong et al. [3], some students in the senior high school level ranged from 15–19 years old (even 20 years old due to acceleration or repetition if the course was not initially completed). The majority have monthly allowances of 1000 PhP and below (61.4%) which is relatively low, followed by monthly allowances of 1001–3000 PhP (33.5%), with the remainder having higher allowances. Lastly, the majority of the respondents do not have relatives who took chemistry-related courses (83.1%) (only 16.9% answered otherwise). With the 42-item constructs and 971 valid responses, a total of 971 $\times$ 42 datasets were considered in this study.

A test for the data collection was conducted for normality using the Shapiro–Wilks Test. The value was within the threshold of $\pm$1.96, which indicated a normal dataset [3]. It could be noted that several questions such as BC1 and BC2 can be debated to be inclined with control (perceived behavioral control) since Sheldrake et al. [38] explained how the enjoyment in class reflects interest toward the subject matter. Thus, if there is a negative experience (or if students are not enjoying the lesson), they will not be engaged in class. This was therefore included in the control aspect of behaviors in this study. For BC2, Sheldrake et al. [38] also explained how the learning environment of students affects their liking and interest in the lesson or subject matter. In accordance, the common method bias (CMB) using Harman's single factor test was conducted with a threshold of less than 50% [35,39] to determine the applicability of items in their respective variables. The current dataset resulted in 35.02% which indicated that there is no CMB present.

The methodology employed started with the data collection followed by testing its acceptability. Performing data pre-processing adopted from different studies [23,26,39] was conducted. Data normalization and parameter settings for both algorithms were considered.

Thereafter, the validation of the parameters was conducted as an initial optimization with a minimum threshold. Lastly, model creation, choosing best parameters, final model generation, model validation, and interpretation were performed. Figure 2 represents the methodological framework of the study.

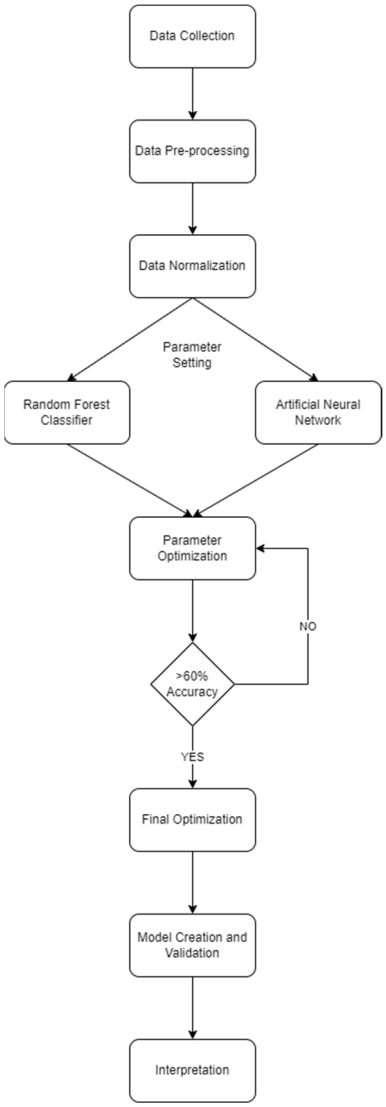

Figure 2. Methodological framework.

3.2. Random Forest Classifier

Random forest classifier (RFC) is a type of machine learning algorithm used for classification. Chen et al. [40] stated how RFC generates a better classification model compared to the normal decision tree, as it generates the best tree with a higher accuracy rate. Ong et al. [24,25] utilized RFC to classify human factors in the adaptation and actual use of an application. It was seen that RFC is one of the best tools to analyze factors influencing decision-making among individuals. In accordance, data cleaning was also utilized in this study using correlation analysis.

A threshold of 0.20 was set for the coefficient, with a 0.05 *p*-value for acceptance. Following the study of German et al. [35], it was suggested that indicators below 0.20 should be removed since they present little to no significant relationship. Based on the threshold, all indicators were deemed significant ($\geq$0.20)—similar to the study of Gumasing et al. [26]. In light of this, data aggregation through the use of mean values was considered to focus on the latent variables considered. No missing values were observed and no values were

dropped in the data pre-processing stage. Lastly, the min–max scalar package was utilized for data normalization. Running the RFC in Python Integrated Development Environment—Spyder 5.0, different parameters were optimized to produce the best tree adopted from studies [24,25,39]. The sklearn package was utilized in the RFC algorithm. Criterion such as entropy or gini, training testing ratios of 60:40 until 90:10, splitters such as random or best, and tree depths from 4 to 7 were considered. With 100 runs per combination, a total of 6400 runs were analyzed in this study.

3.3. Artificial Neural Network

An artificial neural network (ANN) has been utilized nowadays as a hybrid with SEM to classify factors affecting human behavior [23,26]. As a model that mimics how the neurons transfer signals to the brain, studies have concluded that the complex calculation present in this type of MLA can generate more accurate results that would cover the limitations of SEM [24,41]. Yuduang et al. [23] considered a SEM–ANN hybrid to determine factors affecting a mental health mobile application's perceived usability among individuals. It was seen that the results of ANN were able to predict factors affecting human behavior effectively. In addition, Kalinić et al. [42] evaluated consumer satisfaction using ANN. They demonstrated how this type of MLA can determine factors efficiently despite the presence of noise from the dataset and can highlight significant factors despite the non-linear relationship present.

Following the same data pre-processing from RFC, the ANN parameters were also optimized to generate the optimum model. The different activation functions of the hidden layer (tanh, relu, softmax) and output layer (softmax, sigmoid, swish) were considered following several studies [42–44]. In addition, the optimizers (adam, RMSProp, and SGD) were also considered for the optimization process [45–47]. The ANN algorithm was run in this study using Python Integrated Development Environment—Spyder 5.0 with Tensorflow. Keras as the package. Moreover, the class was set to have 5 indicators or normal distribution of the dataset following the 5-point Likert Scale survey response. Similar to other studies [23–26,39], the parameters were adopted from several pieces of literature which were analyzed per combination. With 10 runs per combination (three hidden layer activation functions, three output layer activation functions, and three optimizers), a total of 27,000 iterations (all possible combinations with a division of 10 nodes, until 100 nodes in the hidden layer) were conducted under 150 epochs.

4. Results

4.1. Random Forest Classifier

The results for the RFC from the optimum tree depth (which is five) are presented in Table 2. It could be seen that a 93% accuracy rate with a 0.00 standard deviation was produced using gini as the criterion and best as the splitter. In addition, the precision based on the F1 score presented the highest value of 93.30 and a low standard deviation of 0.823. Utilizing analysis of variance, no significant difference was seen among the results presented. Thus, the highest accuracy with the lowest standard deviation was considered.

The best tree from RFC is presented in Figure 3. It could be seen that attitude towards chemistry (X1) will be the parent node to determine the future intentions of students enrolling in chemistry-related courses. This will then lead to perceived behavioral control (X0). Having a value less than or equal to 2.13 will indicate X0; having values less than or equal to -0.412 will point to X1. If this is not satisfied, this will consider only a high future intention to enroll in chemistry-related courses; otherwise, it will consider autonomy (X2) with a value less than or equal to -0.909, which will lead to very high future intentions to enroll in chemistry-related courses. Nonetheless, if X0 will not be satisfied, it will still consider X0, which will lead to very high future intentions to enroll in chemistry-related courses. If the child node X0 with a value less than or equal to 2.13 will not be satisfied, it will consider X1 and X2, which will lead to high future intentions to enroll in chemistry-related courses.

Table 2. Decision tree mean accuracy (depth = 5).

Category	60:40:00	F1 Score	70:30:00	F1 Score	80:20:00	F1 Score	90:10:00	F1 Score
				Random				
Gini	89.70	90.20	88.00	89.00	89.90	91.00	88.50	89.30
Std. Dev	4.186	3.706	3.469	2.616	3.355	2.261	2.133	2.066
Entropy	91.50	90.67	94.90	96.00	93.40	92.67	93.00	92.50
Std. Dev	3.178	1.936	2.540	1.658	1.561	2.345	2.566	2.587
				Best				
Gini	91.30	92.50	90.12	91.10	93.00	93.30	90.50	91.60
Std. Dev	0.929	1.178	1.037	1.912	0.00	0.823	1.014	1.075
Entropy	92.00	90.56	91.00	90.44	89.93	90.40	89.50	90.20
Std. Dev	0.000	0.527	0.000	0.882	0.00	0.527	0.693	1.302

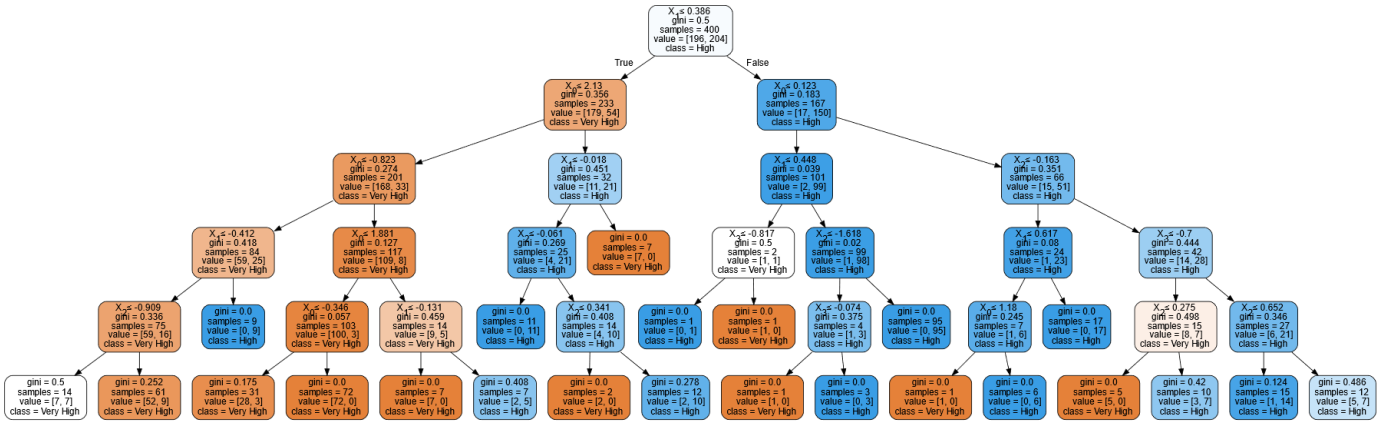

Figure 3. Random Forest Classifier Model. X0—Perceived Behavioral Control (PBC). X1—Attitude towards Chemistry (AC). X2—Autonomy (AU). X3—Affective (AF).

For a child node X0 with a value less than or equal to 0.123, satisfying this will lead to X1 and affective behavior (X3), with a value less than or equal to −0.817. Satisfying this will lead to high future intentions to enroll in chemistry-related courses. If the child node X0 is not satisfied, it will consider X2 with a value less than or equal to −0.163, which will lead to X1 and X0 (this indicates very high future intentions to enroll in chemistry-related courses). Otherwise, it will consider X3 and X2 which will lead to high future intentions to enroll in chemistry-related courses. Therefore, it could be deduced that X1 will be the key indicator for very high future intentions, together with X0. Both X2 and X3 are significant factors as well, which will lead to high future intentions. However, similar to the discussion made by Ong et al. [24,25], only highly significant factors are indicated in the RFC results; thus, there is a need to consider other MLAs such as ANN to identify the most to least significant factor affecting human behavior. In this case, the intent is to elucidate on future intentions to enroll in chemistry-related courses.

4.2. Artificial Neural Network

The result of ANN produced a high accuracy rate of 98.50% with an F1 score of 97.63% for the average precision rate. Presented in Figure 4 is the training and testing validation results for the final run of ANN with 200 epochs. It could be seen that no overfitting was present having the training (blue) and validation (green) loss rates aligned. This indicates the acceptability of the model with no over(under)fitting similar to the findings of other studies [23,26]. To further validate the findings, the precision rate was recorded to be 97.12% and 98% for the recall values. It should be noted that the loss rates may be strikingly identical, but the training loss rate plotting had symbols, which are larger in size. The loss

rates are relatively close, but not identical. Following this is Table 3, which represents the average testing and training results of the different latent variables for the initial ANN run.

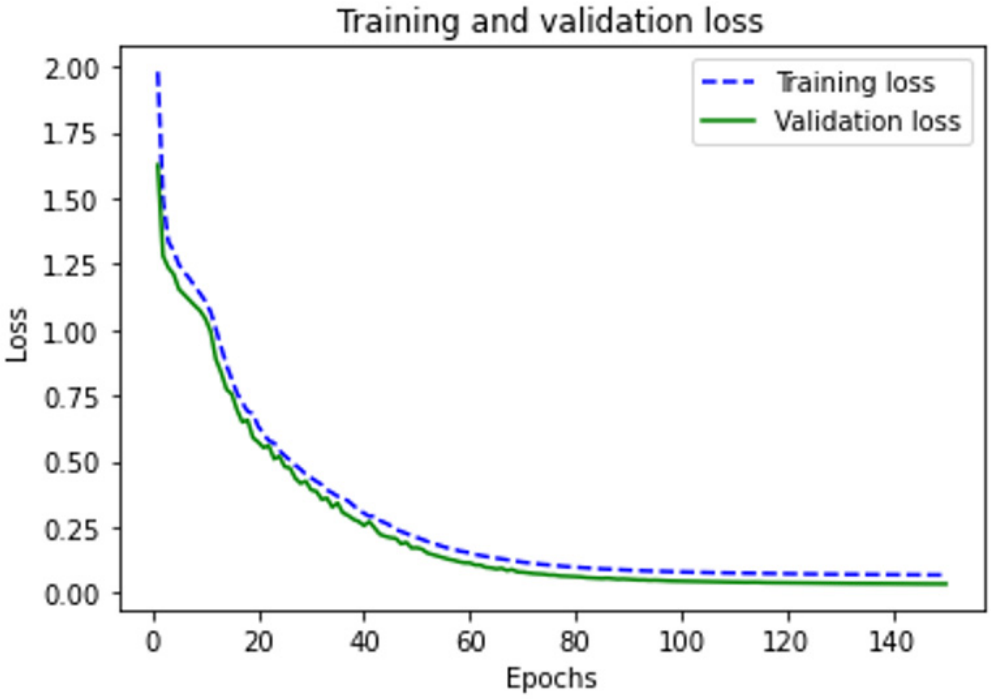

Figure 4. Training and Validation Result.

Table 3. Summary of initial artificial neural network results.

Latent	Average Training	StDev	Average Testing	StDev	F1 Score	StDev
Affective	92.00	4.447	96.41	4.439	95.56	3.210
Attitude Towards Laboratory	80.78	2.108	84.70	3.005	85.97	3.368
Attitude Towards Chemistry	94.25	0.888	98.29	0.784	97.26	1.478
Perceived Behavioral Control	92.51	1.159	98.12	0.294	97.11	1.671
Autonomy	92.43	2.005	96.07	1.651	94.86	2.847
Relatedness	80.21	0.623	85.39	4.440	86.17	3.087
Competency	89.85	1.634	95.90	1.849	94.77	2.898

It could be seen that attitude towards chemistry (AC) gained the highest average testing result, followed by perceived behavioral control (PBC), affective (AF), autonomy (AU), competency (CO), relatedness (RS), and attitude towards laboratory (AL). To verify the results presented, the score of importance was generated as presented in Table 4. Using the optimum parameters of sigmoid for the hidden layer, softmax for the output layer, adam as the optimizer, and an 80:20 training testing ratio, the results in Table 4 are consistent.

Table 4. Score of importance.

Latent	Abbreviations	Importance	Score (%)
Attitude Towards Chemistry	AC	0.180	100
Perceived Behavioral Control	PBC	0.168	93.0
Affective	AF	0.163	90.1
Autonomy	AU	0.144	80.0
Competency	CO	0.134	74.5
Relatedness	RS	0.109	60.3
Attitude Towards Laboratory	AL	0.109	60.3

The Shapley value was utilized in the score calculation of importance. Python Integrated Development Environment—Spyder 5.0 considered in this study followed the SHAP library package with calculations using equation 1. This method was employed since the input variables may change depending on the need of the algorithm. In addition, the generalizability based on calculation would be easier [48]. Karim et al. [49] explained that the SHAP interpretation results in the overall applicability when it comes to the collection of datasets, classifying the contribution and effect of each latent variable in the model. Taking the results into account, each of the variable classifications was deemed to be consistent throughout the analysis. The optimum ANN model is therefore presented in Figure 5.

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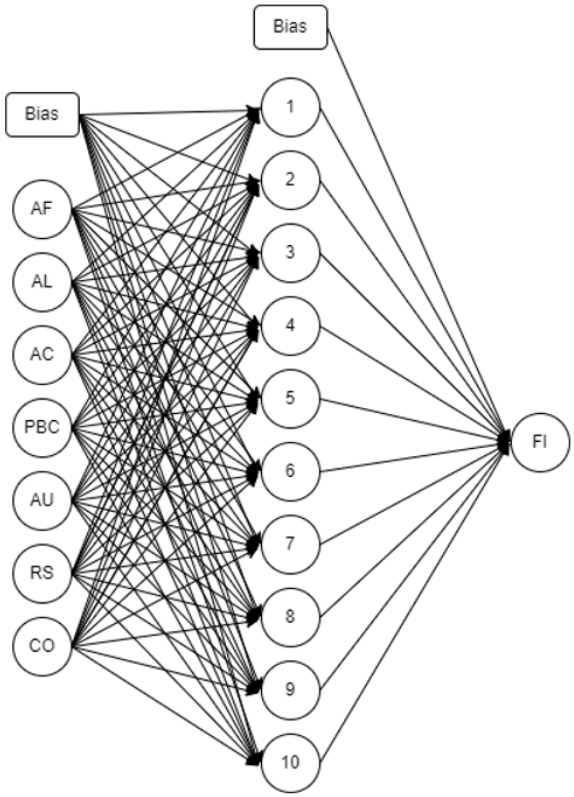

Figure 5. Optimum artificial neural network model. (Left: input layer—latent variables indicated in Table 4; Middle: Hidden layer with number of nodes; Right: Future intention (FI) as the output layer).

In accordance, the test for error rates for both algorithms utilized in this study was conducted. Following the study of German et al. [39], the Taylor diagram (as seen in Figure 6) shows the accuracy rate validation among RFC and ANN. The Taylor diagram was run using Python Integrated Development Environment—Spyder 5.0 with the seaborn package. It was indicated that the Taylor diagram shows the relationship between the accuracy rates with the root mean square error (RMSEA), correlation, and standard deviation [50]. German et al. [39] set the minimum threshold of 20% for RMSEA and 90% for the correlation coefficient. It could be seen from the results that the RMSEA values are less than 20% with consistent factors of latent variable ranking with the RFC and ANN results. Thus, it indicates acceptable and valid results of the machine learning algorithms. All factors were deemed highly significant while both RS and AL were relatively significant.

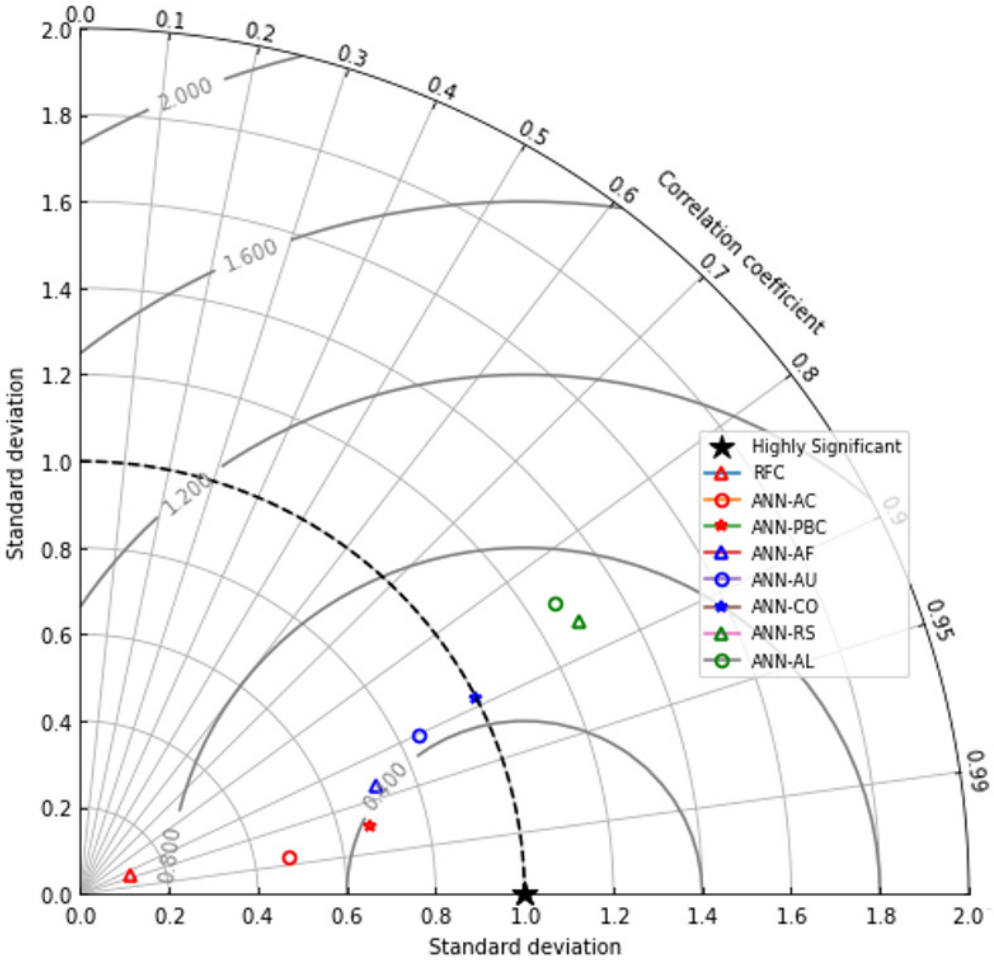

Figure 6. Taylor diagram.

5. Discussion

The results of the machine learning algorithm (MLA) ensemble presented viable and highly-accurate models. The RFC generated a 93% accuracy and the ANN generated a 98.50% accuracy. Ong et al. [24,25] explained and justified that the results for both MLAs would be sufficient in ranking the factors affecting the future intentions of STEM students to enroll in chemistry-related courses. The results showed that AC would be the key indicator for future intentions both from RFC and ANN, followed by PBC, AF, and AU. From the ANN results, competency (CO) was also seen to be significant; however, both relatedness (RS) and attitude towards laboratory (AL) were relatively low with a score of importance that is almost equal to 60%. The threshold was adopted from the study of German et al. [39]. It was explained that compared to forecasting or predicting outputs, there is a 60% more accuracy comparable when using neural network algorithms [51]. Thus, this threshold has been applied by several studies as aligned with significance level which was proven when random forest classifier and neural network results were compared with multivariate tools such as structural equation modeling [24,25,39].

AC would be the most significant indicator in identifying STEM students' future intention to enroll in chemistry-related courses. The indicators showed that students are interested in chemistry to begin with, look forward to chemistry classes, and believe that taking up the STEM strand leads to a more in-depth coverage of chemistry lectures. This presents how the attitude towards a subject matter affects the choices made among students, similar to the study conducted by Dewberry and Jackson [36] from Cyprus. As indicated in the study of Ong et al. [3], students with a positive attitude toward a subject matter in the educational setting would coincide with their decision in their future intentions. Relating

to this study, STEM students are observed to have liked chemistry, which leads to having the most significant effect in future intentions. In accordance, it was observed that they have behavioral control over their decision as well.

PBC was shown to have a high significance to future intentions. Students were seen to enjoy chemistry classes, perceive that teachers can explain, apply, and demonstrate concepts to enhance knowledge and skills in chemistry, and have the urge to perform well in chemistry classes. Hagger and Hamilton [52] posited that students who are more interested in a subject matter are more inclined to learn it in a deeper sense. This demonstrates that students would want to pursue the career path due to their interests and how the subject was catered to them. This means that the educator plays a significant role in influencing the intention of students to pursue the course. As explained in the study of Shwartz [2], environmental, behavioral, and personal factors are key indicators for students to pursue the choice in higher education. With the lack of chemistry-related professionals, AC and PBC could be considered for building intentions and motivations by educators to enhance the interests of students in the application of chemistry and its related fields in higher education.

AF was proven to be the third highest significant factor. Students were able to find learning chemistry to be interesting and easy, and would like to learn chemistry deeper. With AF being the emotional aspect of behavior towards something, this positive effect caused a significance trend in the future intentions of students. Masek et al. [53] supported these findings and indicated that when students align their emotions (such as liking a subject matter), they would have a positive intention to pursue this due to interest. However, Hsia et al. [54] explained that even in earlier times, universities have struggled to obtain enrollees for transfer or retention. Thus, it would be beneficial to instill the interest of students at the early stage of learning and continue in the higher level of education. At the same time, their emotional aspects, such as liking chemistry, may be capitalized upon by the university to pursue the same subject in the institution [3].

AU was a significant factor leading to students' wanting to understand chemistry to learn more about the things around them. It was explained that if students are given the chance to take on projects and learn more, they would perceive learning chemistry as being interesting rather than being a choice [3]—which is one of the indicators of AU in this study. In addition, it could be posited that students want to learn chemistry to understand everything around them. It was also seen from the indicators how learning chemistry became a choice in their current state and how students would want to do better in class. When they are eager to learn, then they would consider this for future and higher education [55]. Jayawardena et al. [55] stated that students' predicament in education would lead to positive future intentions. Similarly, different studies [52,56] justified the findings of this study by indicating how a student's choice is based on their interest and liking rather than influenced by others. Lin et al. [57] discussed how at this stage, both in age and education level, students would want to decide on their own for their future career path. It could therefore be deduced that AU is one of the contributing factors affecting the future intention to enroll in chemistry-related courses among STEM students.

CO was seen to be relatively significant among other latent variables. There is a relationship with regards to students' comprehension in learning chemistry, keenness to solve problems, and application of chemistry in a real-life scenario. The difficulty of applying and extending chemistry outside of classes was seen to be the challenge that led to CO being relatively significant. It was observed from the study of Şen et al. [58] that success factors among students consider their grade point average and even whether they obtain a scholarship. However, it was indicated from the study by Ong et al. [3] that when students are comfortable and interested in what they want to learn, they would pursue it in their higher education. Similarly, Su et al. [59] discussed how interest rather than grades, is a key contributor to students' future intentions. These studies present that CO is one of the significant factors, but not the main latent variable for the determination of future intention. Thus, this justifies the relationship of CO as a significant latent variable in this study.

Both RS and AL were seen to be the least significant factors. Based on the indicators, it was seen that the influence of important people around an individual would lead to a high significance of RS. However, as seen in the demographics, only 16.9% of respondents have relatives who pursued chemistry-related courses, while 83.1% have none. This justifies why RS is one of the least significant latent variables, which posits that students are not influenced by other people when taking up chemistry-related courses; rather, it is their own choice, which could indicate sustainability in taking up the course. Hagger et al. [52] indicated that students would continue pursuing the same course when it is their choice rather than if they are influenced. Guerin and Toland [17] also support the findings of this study—how RS is not the most significant factor for students' future intention in the United States.

In addition, AL was seen to be the least significant. Since the students who responded in the online survey experienced three years of online classes, they were not able to conduct laboratory exercises and experiments. This may have hindered the significance of this latent variable. However, there have been online experiments available, but this may not be sufficient which is why AL was seen to be relatively significant. Sneddon and Douglas [60] explained that the influence of the practical application of theoretical lessons would enhance the interest of students in the subject matter. Experiments should be presented and demonstrated as enjoyable, fun, and interesting in order to engage the students and gain their attention. Estriegana et al. [61] also presented the same results and explained how virtual laboratories should possess similar characteristics to obtain students' attention and interest. Due to the abrupt transition from classroom to online learning, universities could not prepare as much for the course works, which led to an average demonstration of laboratory experiments and exercises [62–64].

STEM students' future intention to enroll in chemistry-related courses considered the delivery of lessons and their interest in pursuing this career. Students are deemed interested in applying chemistry to help society as indicated in the AU latent variable, feel belonging as indicated in AC and CO latent variables, and are knowledgeable about the available opportunities in the career paths as indicated in the PBC and AF latent variables. It could be deduced that universities should enhance their chemistry-related programs, encouraging students to pursue the track in their higher education levels. This would eventually create more professionals in the aforementioned field.

5.1. Theoretical and Practical Implications

Based on the results, it could be posited that machine learning algorithms such as RFC and ANN can measure human factors in the education setting. Following the suggestion of Ong et al. [3] and German et al. [25,35], intentions and behavioral factors may be assessed and evaluated utilizing these tools—a substitute for multivariate tools with a higher accuracy rate of classification and prediction. As support, the analysis of Yuduang et al. [23] presented the SEM and neural network analysis of factors affecting mobile application adoption and showcased how the nonlinear relationships may be accurately measured with neural networks than SEM. Moreover, both Woody [20] and Fan et al. [21] explained how the distance of the latent variable to the dependent variable greatly affects their significance. On the other hand, results also indicated how PBC and AC should be considered by universities as part of their education program to enhance the interest and motivation of students in pursuing chemistry-related courses. It could be deduced that students with interest and passion would lead to continuing higher education in the field. Therefore, the framework and construct of this study may be applied and extended to evaluate other areas and courses of education.

In addition, AU and AF showed to be significant factors leading to high future intentions. Thus, universities may consider evaluating students' interests and likes to determine which track best suits the students for higher education. Not only will this help universities to retain students in their respective tracks but will also encourage students to pursue their future career goals. This could therefore be part of the marketing strategy among

universities. They could highlight how the effective evaluation of students could lead to the proper alignment of what students are interested in, what courses would be suited, and what career goals are suitable for them. With these, student retention and continuing education may be applied to universities leading to higher marketability and profitability.

5.2. Limitations

Despite the significant findings and contribution both from the results and methodological standpoint, this study still considers several limitations. First, this study only evaluated chemistry-related courses. Future research may consider analyzing other fields of education to generalize the findings of this study. In addition, the extension of another knowledge management [65] may also be analyzed and considered. Second, this study only measured future intentions. It could be extended by analyzing factors affecting students who are currently taking up the course and evaluating their satisfaction, change in behavior, and interest. This would lead to the evaluation of other factors that may be considered as an extension for future intention and motivation. In addition, attitude towards the learning environment may also be analyzed as an extended factor, covering various aspects such as the teacher, lesson plan, provided support, and the like. To further assess the implications of the study, a follow-up analysis of students who answered the survey may be conducted. The determination of students' responses to positive future intentions may be conducted to correlate the findings. Third, the analysis of implications for future intentions may be conducted in other countries since the current study only covered students in private schools in the Philippines. The public school setup and the difference in geographical location, country, and class modality may be analyzed to present the different behavioral factors affecting students' intention to enroll in chemistry-related courses. Lastly, this study only considered RFC and ANN. Despite the high accuracy rate, other machine learning algorithms may be analyzed such as K-Nearest Neighbors, K-Means, or even PSO and Fuzzy C-Means, and Naïve Bayes for clustering and probability-focused assessment of indicators and latent variables.

6. Conclusions

The need for chemistry-related professionals has been evident in the current generation. The need to focus also on environmental fields has been evident nowadays. The assessment of factors affecting future intentions to enroll in chemistry-related courses is needed to determine how students would engage with their chosen career path. This study considered utilizing a machine learning ensemble of random forest classifier and artificial neural networks to measure human behavior among STEM students. Factors under TPB and SDT were evaluated simultaneously to assess future intentions among students.

With 93% accuracy for RFC and 98.5% for ANN, results showed that the main predicament for future intentions would be the attitude of the subject and perceived behavioral control. These two factors would lead to very high significance for students to have a positive response towards their future intention in choosing a course for higher education. It was also seen that affective behavior and autonomy are significant factors that affect future intentions. The results showed that students' interest (AC and AF), enjoyment (PBC), appreciation (AU), and applicability of the subject matter in real-world (CO) would engage them to choose a course, leading to a professional career path based on a positive point of view. These should be considered and capitalized upon by universities to enhance the intentions and behavioral factors of students in choosing chemistry-related courses. It was observed from the indicators that when students understand the subject, its importance, and the influence of teachers on their knowledge and skills, they would likely consider pursuing chemistry-related career paths.

Universities may engage with students in assessing their interests to determine and guide them to their field of passion. Teachers can also consider the findings of this study to help them be engaged in different fields, especially those who are undecided about their future career goals. The framework and methodology utilized in this study may be

applied and extended to other studies related to education in different countries. Lastly, the findings and results discussed may be applied by universities across the world.

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Institutional Review Board Statement: The study was approved by the Mapua University Research Ethics Committees (FM-RC-22-20).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study (FM-RC-21-60).

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The author declares no conflict of interest.

References

1. Brown, C.; Fallucca, A.; Makris, T. Advancing Professional Development Strategies for Undergraduates in Chemistry and Biochemistry. *FASEB J.* **2018**, *32*, 535.22. [CrossRef]
2. Shwartz, G.; Shav-Artza, O.; Dori, Y.J. Choosing Chemistry at Different Education and Career Stages: Chemists, Chemical Engineers, and Teachers. *J. Sci. Educ. Technol.* **2021**, *30*, 692–705. [CrossRef]
3. Ong, A.K.S.; Prasetyo, Y.T.; Pinugu, J.N.J.; Chuenyindee, T.; Chin, J.; Nadlifatin, R. Determining Factors Influencing Students' Future Intentions to Enroll in Chemistry-Related Courses: Integrating Self-Determination Theory and Theory of Planned Behavior. *Int. J. Sci. Educ.* **2022**, *44*, 556–578. [CrossRef]
4. Borges, A.J. A Platform for Connecting and Empowering Early-Career Chemists. Available online: https://www.chemistryviews.org/details/ezine/11325406/A_Platform_for_Connecting_and_Empowering_Early-Career_Chemists/ (accessed on 4 August 2022).
5. Nature Editorial. *Nature Editorial Chemistry Education Needs a Green Reset.* **2022**, *604*, 598.
6. Mahdi, J.G. Student Attitudes towards Chemistry: An Examination of Choices and Preferences. *Am. J. Educ. Res.* **2014**, *2*, 351–356. [CrossRef]
7. Cohen, R.; Kelly, A.M. Community College Chemistry Coursetaking and STEM Academic Persistence. *J. Chem. Educ.* **2019**, *96*, 3–11. [CrossRef]
8. Garcia, J.E.; Feliciano, L.M.L.; Manalo, S.C.; Custodio, J.E.G.; Serito, S.M.M.; Garing, A. Career Aspirations of Stem Students of University of Batangas towards Stem Careers. In Proceedings of the LSU Research Congress 2017, Manila, Philippines, 20–22 June 2017.
9. Hofstein, A.; Mamlok-Naaman, R. High-School Students' Attitudes toward and Interest in Learning Chemistry. *Educ. Química* **2011**, *22*, 90–102. [CrossRef]
10. Burford, C.; Hanrahan, J.; Ansaripour, A.; Smith, B.; Sysum, K.; Rajwani, K.; Huett, M.; Vergani, F.; Zebian, B. In Reply to the Letter to the Editor Regarding "Factors Influencing Medical Student Interest in a Career in Neurosurgery". *World Neurosurg.* **2019**, *126*, 693. [CrossRef] [PubMed]
11. Poort, I.; Jansen, E.; Hofman, A. Does the Group Matter? Effects of Trust, Cultural Diversity, and Group Formation on Engagement in Group Work in Higher Education. *High. Educ. Res. Dev.* **2020**, *41*, 511–526. [CrossRef]
12. Bunce, L.; King, N.; Saran, S.; Talib, N. Experiences of Black and Minority Ethnic (BME) Students in Higher Education: Applying Self-Determination Theory to Understand the BME Attainment Gap. *Stud. High. Educ.* **2019**, *46*, 534–547. [CrossRef]
13. Ryan, R.M.; Deci, E.L. Intrinsic and Extrinsic Motivation from a Self-Determination Theory Perspective: Definitions, Theory, Practices, and Future Directions. *Contemp. Educ. Psychol.* **2020**, *61*, 101860. [CrossRef]
14. Butz, N.T.; Stupnisky, R.H. Improving Student Relatedness through an Online Discussion Intervention: The Application of Self-Determination Theory in Synchronous Hybrid Programs. *Comput. Educ.* **2017**, *114*, 117–138. [CrossRef]
15. Hollett, R.C.; Gignac, G.E.; Milligan, S.; Chang, P. Explaining Lecture Attendance Behavior via Structural Equation Modeling: Self-Determination Theory and the Theory of Planned Behavior. *Learn Individ. Differ.* **2020**, *81*, 101907. [CrossRef]
16. Kurata, Y.B.; Prasetyo, Y.T.; Ong, A.K.S.; Nadlifatin, R.; Chuenyindee, T. Factors Affecting Perceived Effectiveness of Typhoon Vamco (Ulysses) Flood Disaster Response among Filipinos in Luzon, Philippines: An Integration of Protection Motivation Theory and Extended Theory of Planned Behavior. *Int. J. Disaster Risk Reduct.* **2022**, *67*, 102670. [CrossRef]
17. Guerin, R.J.; Toland, M.D. An Application of a Modified Theory of Planned Behavior Model to Investigate Adolescents' Job Safety Knowledge, Norms, Attitude and Intention to Enact Workplace Safety and Health Skills. *J. Saf. Res.* **2020**, *72*, 189–198. [CrossRef]
18. Lung-Guang, N. Decision-Making Determinants of Students Participating in MOOCs: Merging the Theory of Planned Behavior and Self-Regulated Learning Model. *Comput. Educ.* **2019**, *134*, 50–62. [CrossRef]

19. Knauder, H.; Koschmieder, C. Individualized Student Support in Primary School Teaching: A Review of Influencing Factors Using the Theory of Planned Behavior (TPB). *Teach. Teach. Educ.* **2019**, *77*, 66–76. [CrossRef]
20. Woody, E. An SEM Perspective on Evaluating Mediation: What Every Clinical Researcher Needs to Know. *J. Exp. Psychopathol.* **2011**, *2*, 210–251. [CrossRef]
21. Fan, Y.; Chen, J.; Shirkey, G.; John, R.; Wu, S.R.; Park, H.; Shao, C. Applications of Structural Equation Modeling (SEM) in Ecological Studies: An Updated Review. *Ecol. Process.* **2016**, *5*, 19. [CrossRef]
22. Duarte, P.; Pinho, J.C. A Mixed Methods UTAUT2-Based Approach to Assess Mobile Health Adoption. *J. Bus. Res.* **2019**, *102*, 140–150. [CrossRef]
23. Yuduang, N.; Ong, A.K.S.; Vista, N.B.; Prasetyo, Y.T.; Nadlifatin, R.; Persada, S.F.; Gumasing, M.J.J.; German, J.D.; Robas, K.P.E.; Chuenyindee, T.; et al. Utilizing Structural Equation Modeling—Artificial Neural Network Hybrid Approach in Determining Factors Affecting Perceived Usability of Mobile Mental Health Application in the Philippines. *Int. J. Environ. Res. Public Health* **2022**, *19*, 6732. [CrossRef] [PubMed]
24. Ong, A.K.S.; Prasetyo, Y.T.; Velasco, K.E.C.; Abad, E.D.R.; Buencille, A.L.B.; Estorninos, E.M.; Cahigas, M.M.L.; Chuenyindee, T.; Persada, S.F.; Nadlifatin, R.; et al. Utilization of Random Forest Classifier and Artificial Neural Network for Predicting the Acceptance of Reopening Decommissioned Nuclear Power Plant. *Ann. Nucl. Energy* **2022**, *175*, 109188. [CrossRef]
25. Ong, A.K.S.; Chuenyindee, T.; Prasetyo, Y.T.; Nadlifatin, R.; Persada, S.F.; Gumasing, M.J.J.; German, J.D.; Robas, K.P.E.; Young, M.N.; Sittiwatethanasiri, T. Utilization of Random Forest and Deep Learning Neural Network for Predicting Factors Affecting Perceived Usability of a COVID-19 Contact Tracing Mobile Application in Thailand "ThaiChana". *Int. J. Environ. Res. Public Health* **2022**, *19*, 6111. [CrossRef] [PubMed]
26. Gumasing, M.J.J.; Prasetyo, Y.T.; Ong, A.K.S.; Nadlifatin, R.; Persada, S.F. Determining Factors Affecting the Perceived Preparedness of Super Typhoon: Three Broad Domains of Ergonomics Approach. *Sustainability* **2022**, *14*, 12202. [CrossRef]
27. Hiatt, M.S.; Swaim, J.A.; Maloni, M.J. Choosing an Undergraduate Major in Business Administration: Student Evaluative Criteria, Behavioral Influences, and Instructional Modalities. *Int. J. Manag. Educ.* **2018**, *16*, 524–540. [CrossRef]
28. Wang, C.K.J.; Liu, W.C.; Kee, Y.H.; Chian, L.K. Competence, Autonomy, and Relatedness in the Classroom: Understanding Students' Motivational Processes Using the Self-Determination Theory. *Heliyon* **2019**, *5*, e01983. [CrossRef] [PubMed]
29. White, R.L.; Bennie, A.; Vasconcellos, D.; Cinelli, R.; Hilland, T.; Owen, K.B.; Lonsdale, C. Self-Determination Theory in Physical Education: A Systematic Review of Qualitative Studies. *Teach. Teach. Educ.* **2021**, *99*, 103247. [CrossRef]
30. Naeem, A.; Mirza, N.H.; Ayyub, R.M.; Lodhi, R.N. HRM Practices and Faculty's Knowledge Sharing Behavior: Mediation of Affective Commitment and Affect-Based Trust. *Stud. High. Educ.* **2017**, *44*, 499–512. [CrossRef]
31. Akçayir, M.; Akçayir, G.; Pektaş, H.M.; Ocak, M.A. Augmented Reality in Science Laboratories: The Effects of Augmented Reality on University Students' Laboratory Skills and Attitudes toward Science Laboratories. *Comput. Hum. Behav.* **2016**, *57*, 334–342. [CrossRef]
32. Dicker, R.; Garcia, M.; Kelly, A.; Mulrooney, H. What Does 'Quality' in Higher Education Mean? Perceptions of Staff, Students and Employers. *Stud. High. Educ.* **2018**, *44*, 1425–1441. [CrossRef]
33. Nwagbo, C. Effects of Two Teaching Methods on the Achievement in and Attitude to Biology of Students of Different Levels of Scientific Literacy. *Int. J. Educ. Res.* **2006**, *45*, 216–229. [CrossRef]
34. al Hadid, L.A.; Al-Rajabi, O.; AlBarmawi, M.; Yousef Sayyah, N.S.; Toqan, L.M.D. Exploring Factors That Influence Students' Attitudes toward Midwifery in Jordan: Measuring Psychometric Properties of a Newly Developed Tool. *Nurse Educ. Pract.* **2018**, *29*, 219–224. [CrossRef] [PubMed]
35. German, J.D.; Redi, A.A.N.P.; Prasetyo, Y.T.; Persada, S.F.; Ong, A.K.S.; Young, M.N.; Nadlifatin, R. Choosing a Package Carrier during COVID-19 Pandemic: An Integration of pro-Environmental Planned Behavior (PEPB) Theory and Service Quality (SERVQUAL). *J. Clean. Prod.* **2022**, *346*, 131123. [CrossRef] [PubMed]
36. Dewberry, C.; Jackson, D.J.R. An Application of the Theory of Planned Behavior to Student Retention. *J. Vocat. Behav.* **2018**, *107*, 100–110. [CrossRef]
37. Osma, I.; Kemal, F.E.; Radid, M. Analysis of Determinants and Factors Motivating Students in Higher Education: Case of the Students of Chemistry at the Ben M'sik Faculty of Sciences. *Procedia Soc. Behav. Sci.* **2015**, *197*, 286–291. [CrossRef]
38. Sheldrake, R.; Mujtaba, T.; Reiss, M.J. Science Teaching and Students' Attitudes and Aspirations: The Importance of Conveying the Applications and Relevance of Science. *Int. J. Educ. Res.* **2017**, *85*, 167–183. [CrossRef]
39. German, J.D.; Agung Ngurah Perwira Redi, A.; Kester Ong, A.S.; Tri Prasetyo, Y.; Louis Sumera, V.M. Predicting Factors Affecting Preparedness of Volcanic Eruption for a Sustainable Community: A Case Study in the Philippines. *Sustainability* **2022**, *14*, 11329. [CrossRef]
40. Chen, J.; Li, Q.; Wang, H.; Deng, M. A Machine Learning Ensemble Approach Based on Random Forest and Radial Basis Function Neural Network for Risk Evaluation of Regional Flood Disaster: A Case Study of the Yangtze River Delta, China. *Int. J. Environ. Res. Public Health* **2019**, *17*, 49. [CrossRef]
41. Al-Mashraie, M.; Chung, S.H.; Jeon, H.W. Customer Switching Behavior Analysis in the Telecommunication Industry via Push-Pull-Mooring Framework: A Machine Learning Approach. *Comput. Ind. Eng.* **2020**, *144*, 106476. [CrossRef]
42. Kalinić, Z.; Marinković, V.; Kalinić, L.; Liébana-Cabanillas, F. Neural Network Modeling of Consumer Satisfaction in Mobile Commerce: An Empirical Analysis. *Expert Syst. Appl.* **2021**, *175*, 114803. [CrossRef]

43. Li, M.; Vanberkel, P.; Zhong, X. Predicting Ambulance Offload Delay Using a Hybrid Decision Tree Model. *Socio-Econ. Plan. Sci.* **2022**, *80*, 101146. [CrossRef]
44. Jang, H.S.; Xing, S. A Model to Predict Ammonia Emission Using a Modified Genetic Artificial Neural Network: Analyzing Cement Mixed with Fly Ash from a Coal-Fired Power Plant. *Constr. Build. Mater.* **2020**, *230*, 117025. [CrossRef]
45. Yousefzadeh, M.; Hosseini, S.A.; Farnaghi, M. Spatiotemporally Explicit Earthquake Prediction Using Deep Neural Network. *Soil Dyn. Earthq. Eng.* **2021**, *144*, 106663. [CrossRef]
46. Jena, R.; Pradhan, B.; Beydoun, G.; Nizamuddin; Ardiansyah; Sofyan, H.; Affan, M. Integrated Model for Earthquake Risk Assessment Using Neural Network and Analytic Hierarchy Process: Aceh Province, Indonesia. *Geosci. Front.* **2020**, *11*, 613–634. [CrossRef]
47. Eckle, K.; Schmidt-Hieber, J. A Comparison of Deep Networks with ReLU Activation Function and Linear Spline-Type Methods. *Neural Netw.* **2019**, *110*, 232–242. [CrossRef]
48. Barnard, A.S. Explainable Prediction of N-V-Related Defects in Nanodiamond Using Neural Networks and Shapley Values. *Cell Rep. Phys. Sci.* **2022**, *3*, 100696. [CrossRef]
49. Karim, A.; Su, Z.; West, P.K.; Keon, M.; The NYGC ALS Consortium; Shamsani, J.; Brennan, S.; Wong, T.; Milicevic, O.; Teunisse, G.; et al. Molecular Classification and Interpretation of Amyotrophic Lateral Sclerosis Using Deep Convolution Neural Networks and Shapley Values. *Genes* **2021**, *12*, 1754. [CrossRef]
50. Gholami, H.; Mohamadifar, A.; Sorooshian, A.; Jansen, J.D. Machine-Learning Algorithms for Predicting Land Susceptibility to Dust Emissions: The Case of the Jazmurian Basin, Iran. *Atmos. Pollut. Res.* **2020**, *11*, 1303–1315. [CrossRef]
51. Walczak, S.; Cerpa, N. Artificial Neural Networks. In *Encyclopedia of Physical Science and Technology*, 3rd ed.; Academic Press: Cambridge, MA, USA, 2003; Volume 1, pp. 631–645. [CrossRef]
52. Hagger, M.S.; Hamilton, K. Motivational Predictors of Students' Participation in out-of-School Learning Activities and Academic Attainment in Science: An Application of the Trans-Contextual Model Using Bayesian Path Analysis. *Learn Individ. Differ.* **2018**, *67*, 232–244. [CrossRef]
53. Masek, A.; Paimin@Abdul Halim, A.N.; Hashim, S.; Abdullah, N.S.; Wan Muda, W.H.N. The Role of Knowledge, Emotion, and Intention in Influencing Students' Behaviors During COVID-19 Pandemic. *SAGE Open* **2022**, *12*, 21582440221089954. [CrossRef]
54. Hsia, T.C.; Shie, A.J.; Chen, L.C. Course Planning of Extension Education to Meet Market Demand by Using Data Mining Techniques—An Example of Chinkuo Technology University in Taiwan. *Expert Syst. Appl.* **2008**, *34*, 596–602. [CrossRef]
55. Jayawardena, P.R.; van Kraayenoord, C.E.; Carroll, A. Factors That Influence Senior Secondary School Students' Science Learning. *Int. J. Educ. Res.* **2020**, *100*, 101523. [CrossRef]
56. Bartimote-Aufflick, K.; Bridgeman, A.; Walker, R.; Sharma, M.; Smith, L. The Study, Evaluation, and Improvement of University Student Self-Efficacy. *Stud. High. Educ.* **2015**, *41*, 1918–1942. [CrossRef]
57. Lin, G.; Shen, W. Research on Convolutional Neural Network Based on Improved Relu Piecewise Activation Function. *Procedia Comput. Sci.* **2018**, *131*, 977–984. [CrossRef]
58. Şen, B.; Uçar, E.; Delen, D. Predicting and Analyzing Secondary Education Placement-Test Scores: A Data Mining Approach. *Expert Syst. Appl.* **2012**, *39*, 9468–9476. [CrossRef]
59. Su, M.-S.; Chang, T.-C.; Wu, C.-C.; Liao, C.-W. Factors Affecting the Student Career Decision-Making of Junior High School Students in Central Taiwan Area. *Int. J. Inf. Educ. Technol.* **2016**, *6*, 843–850. [CrossRef]
60. Sneddon, P.H.; Douglas, R. The Attitudes towards, and Experiences of, Laboratory Teaching in Year 1 Chemistry and Physics University Courses. *New Dir. Teach. Phys. Sci.* **2013**, *9*, 49–54. [CrossRef]
61. Estriegana, R.; Medina-Merodio, J.A.; Barchino, R. Student Acceptance of Virtual Laboratory and Practical Work: An Extension of the Technology Acceptance Model. *Comput. Educ.* **2019**, *135*, 1–14. [CrossRef]
62. Prasetyo, Y.T.; Tumanan, S.A.R.; Yarte, L.A.F.; Ogoy, M.C.C.; Ong, A.K.S. Blackboard E-Learning System Acceptance and Satisfaction among Filipino High School Students: An Extended Technology Acceptance Model (TAM) Approach. In Proceedings of the 2020 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Singapore, 14–17 December 2020; pp. 1271–1275. [CrossRef]
63. Prasetyo, Y.T.; Ong, A.K.S.; Concepcion, G.K.F.; Navata, F.M.B.; Robles, R.A.V.; Tomagos, I.J.T.; Young, M.N.; Diaz, J.F.T.; Nadlifatin, R.; Redi, A.A.N.P. Determining Factors Affecting Acceptance of E-Learning Platforms during the COVID-19 Pandemic: Integrating Extended Technology Acceptance Model and DeLone & McLean IS Success Model. *Sustainability* **2021**, *13*, 8365. [CrossRef]
64. Ong, A.K.S.; Prasetyo, Y.T.; Young, M.N.; Diaz, J.F.T.; Chuenyindee, T.; Kusonwattana, P.; Yuduang, N.; Nadlifatin, R.; Redi, A.A.N.P. Students' Preference Analysis on Online Learning Attributes in Industrial Engineering Education during the COVID-19 Pandemic: A Conjoint Analysis Approach for Sustainable Industrial Engineers. *Sustainability* **2021**, *13*, 8339. [CrossRef]
65. Natek, S.; Zwilling, M. Student Data Mining Solution–Knowledge Management System Related to Higher Education Institutions. *Expert Syst. Appl.* **2014**, *41*, 6400–6407. [CrossRef]

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Review

Strengthening the Teaching and Research Nexus (TRN) in Higher Education (HE): Systematic Review of Reviews

Adriano Simao Uaciquete [1,2,*] and Martin Valcke [2]

[1] Department of Organization and Management of Education, Faculty of Education, Universidade Eduardo Mondlane, Maputo 257, Mozambique
[2] Department of Educational Studies, Faculty of Psychology and Educational Sciences, Ghent University, 9000 Ghent, Belgium
* Correspondence: adrianosimao.uaciquete@ugent.be

Abstract: Background: The linkage between teaching and research—also labelled the Teaching Research Nexus (TRN)—is the object of a recurrent debate in higher education. The debate centres on the nature of the interrelation, TRN benefits and challenges, concrete TRN strategies, and its impact on students and academics. Methods: Based on a systematic search of papers published between 2012 and 2022, a systematic review of review studies was conducted, building on articles from the Web of Science and Scopus. Results: From an initial 151 records, 14 fit the review inclusion/exclusion criteria. Goal and review questions: To provide researchers, teachers, and policy decision-makers with an overview of TRN in higher education based on available peer-reviewed review studies, this systematic review was driven by the following guiding questions: What are the conceptual developments in TRN definitions? What are the outcomes of experimental TRN interventions? What are the implementation challenges of TRN in higher education? What TRN implementation strategies have been adopted? Finally, what do the reviews stress as future directions for TRN? Brief conclusion: The review results helped identify patterns in TRN studies, practices, and directions for future TRN research in higher education.

Keywords: teaching research nexus; higher education; concept; benefits; strategies; challenges; future direction; reviews; systematic review

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1. Introduction

Worldwide, higher education systems face challenges resulting from their expansion, diversification, massification, and questions concerning their social relevance [1–3]. This has had an internal and external impact on the university environment. Externally, universities face accountability questions by constituents and stakeholders; how they deal with the increasing diversification of the student population and the jeopardy in designing and executing their own intellectual agenda [4]. Internally, these impacts have been observed in the way universities reorganize their structure, redefine their mission, and reconsider the relationship between teaching and research [5–7]. Teaching and research are two major functions of higher education institutions (HEI). Therefore, the questions concerning their relationship are not surprising, and are part of a recurrent debate in the higher education literature [7].

During the last decade, both non-systematic and systematic review papers have been published focusing on TRN in higher education. The debate has often created controversies, since it involves multiple university stakeholders with diverging interests [8]. On the other hand, the value of the teaching-research nexus remains unclear [9]. Non-systematic reviews do provide relevant summaries about TRN practices in higher education, and are a source of ideas, information, context, and arguments both in favour and against. However, they are not comprehensive or controlled in terms of the selection and inclusion of empirical studies. Systematic reviews, in contrast, help address potential bias and can fulfil the

role of a scientific gyroscope with an in-built self-righting mechanism [10]. However, a comprehensive overview of the patterns and results of review studies has not yet been conducted. Thus, the current study offers a review of systematic review studies conducted on TRN in higher education.

2. Trends in TRN Research

Though popular, resilient, and widespread, the relative importance of teaching and research and their relationship have been intensely contested [11]. While in the English higher education tradition, teaching and research were seen as better carried out in separate institutions, in the German tradition, by contrast, one sees the unity of teaching and research as the core university business. In the American tradition, both roles are regarded as co-existing in varying relations alongside community service and industrial consultancy [12,13]. The English higher education tradition is anchored in the Ruth Newman idea of a university; the German tradition is closely connected to the Von Humboldt idea of a university; and the America tradition is associated with the Clark Kerr idea of a university. Following these traditions, and incorporating conceptual debates [12,14], the discussion also expands to the empirical and pedagogical level [15]. Recently, the discussion has influenced policy reforms and the ranking of university systems in the post-pandemic world [16].

At the conceptual level, the debate focuses on the nature and the idea of a university and higher education in general [13]. These discussions were fuelled by [17], who reviewed TRN models based on expected relationships (positive, negative, neutral) and TRN models, within which various moderators and interaction variables are considered.

At the empirical or pedagogical level, both qualitative or quantitative approaches [7,18–20] have been adopted to analyse TRN and develop evidence about its benefits, challenges, strategies, and future directions. The quantitative studies typically assess linear correlations between the output of teaching and research activities, respective research productivity, and teaching effectiveness. Most quantitative studies conclude that teaching and research (i.e., the output of both activities) are, at most, marginally correlated [20]. However, there are questions concerning the use of quantitative analysis of the relationship between research and teaching. Alternative approaches build on partial correlations that control the influence of a set of specific variables [19]. Available qualitative research studies emphasize this TRN complexity and adopt interview tools, focus groups, case studies, and reflective approaches to explore the nexus, academic conceptions of "teaching" and "research" at the level of disciplines and departments, and the impact of institutional, disciplinary, and other contextual factors influencing student experiences of research [21]. Qualitative studies usually report a strong belief among university stakeholders that teaching and research are positively related. Specifically, most respondents indicate that this positive relationship predominantly works in one way, with the impact of research on teaching being far more important than the other way around [8].

In addition to the two abovementioned levels, a more recent debate has focused on the societal impact of higher education, with questions about global expansion, diversification, massification, the social relevance of higher education, the vocational dimension of higher education, and the high-specialisation of research in the post-pandemic world. Within this debate, TRN has been introduced as an idea, a theory, a practice, or a catchphrase, as well as a model, a framework, a policy, or a concept [13]. These variations—and their related ambiguities—result from the fact that they are often found in policy-making statements, policy documents for HE, mission statements of universities and other institutions of higher education, etc. (see [5,7]). However, "authors, academics, and policymakers tend to slip between different meanings in an unacknowledged and usually unrecognized way" [22] (p.3). Therefore, the way in which the "nexus" is described in case studies and in the literature reflects the multiple linkages and relationships being referred to [18]. These linkages about the TRN have been primarily perceived as: (a) "functional interdependence" of two academic roles; (b) "conceptual connections" between teaching and research; and

finally, as (c) arguments about the roles of graduate and postgraduate students in the context of contemporary "knowledge societies".

Over time, the reconceptualization of TRN has led to implications for "theory" and "enhancements efforts" in terms of: (i) a deeper appreciation of wider social structural forces in thinking about the nexus; (ii) conceptions of teaching and research—and the linkages between them—as drawing on wider ideological resources which have structural roots; (iii) comprehending ideologically-founded sets of compatibilities and incompatibilities between teaching and research; and (iv) considering differences in the cultures of institutions.

During the last decade, both non-systematic and systematic review papers have been published focusing on TRN in higher education. Review studies are conducted to illustrate the broader picture of a particular topic or focus within a discipline with the purpose of examining the changes and evolution of a discipline to provide scholars with a better understanding of the development of a field and discover any trends [23].

However, the growing number of reviews focusing on TRN in higher education again raises new questions, as different conclusions, challenges, and results are continuously being presented. This seems partly related to the nature of the review itself. Based on a review typology [24] and approaches to synthesizing research [10], three types of reviews can be distinguished: traditional literature reviews, critical reviews, and systematic reviews. Additionally, a review of available TRN review studies is—to our knowledge—currently not available. Therefore, the aim of the present study is to provide researchers, teachers, and policy decision-makers with an overview of TRN in higher education based on available peer-reviewed review studies. Based on the above, we put forward the following guiding research questions:

RQ 1: What are the conceptual approaches and potential changes available in the definitions of the TRN in higher education when looking at TRN reviews?

RQ 2: What are the benefits of an experimental TRN intervention as perceived by academics and students, and as stressed in the review studies?

RQ 3: What are the perceived challenges as to the implementation of the TRN in higher education as stressed in the review studies?

RQ 4: What concrete TRN implementation strategies are discussed in the TRN reviews?

RQ 5: What are the future directions of the TRN in higher education according to TRN reviews?

3. Methodology

3.1. Data Collection

To conduct the systematic review of review studies, we followed the PRISMA guidelines (i.e., preferred reporting items for systematic reviews and meta-analyses) and protocol of the PRISMA Group, 2020 [25]. Review studies published in English between 2012 and 2022 were included in the process, which were available through the Web of Sciences and Scopus.

An overview of the related process is represented in Figure 1.

3.2. Eligibility Criteria

The systematic literature review was started by searching relevant publications. Two queries were set up: a first query via the Web of Science database, and a second query via Scopus. The purpose of the main query was to identify relevant peer-reviewed research on the topic. On 1 August 2022, the following combinations of search field tags and search terms were used in the Web of Science: Teaching AND Research AND Nexus AND Review. The additional query was TITLE-ABS-KEY ("Teaching Research Nexus") AND "Review". This was repeated using the Scopus database on 4 August 2022. This second query helped identify recent work on the topic, not (yet) included in the Web of Science database. The following time window was consistently applied: 2012–2022.

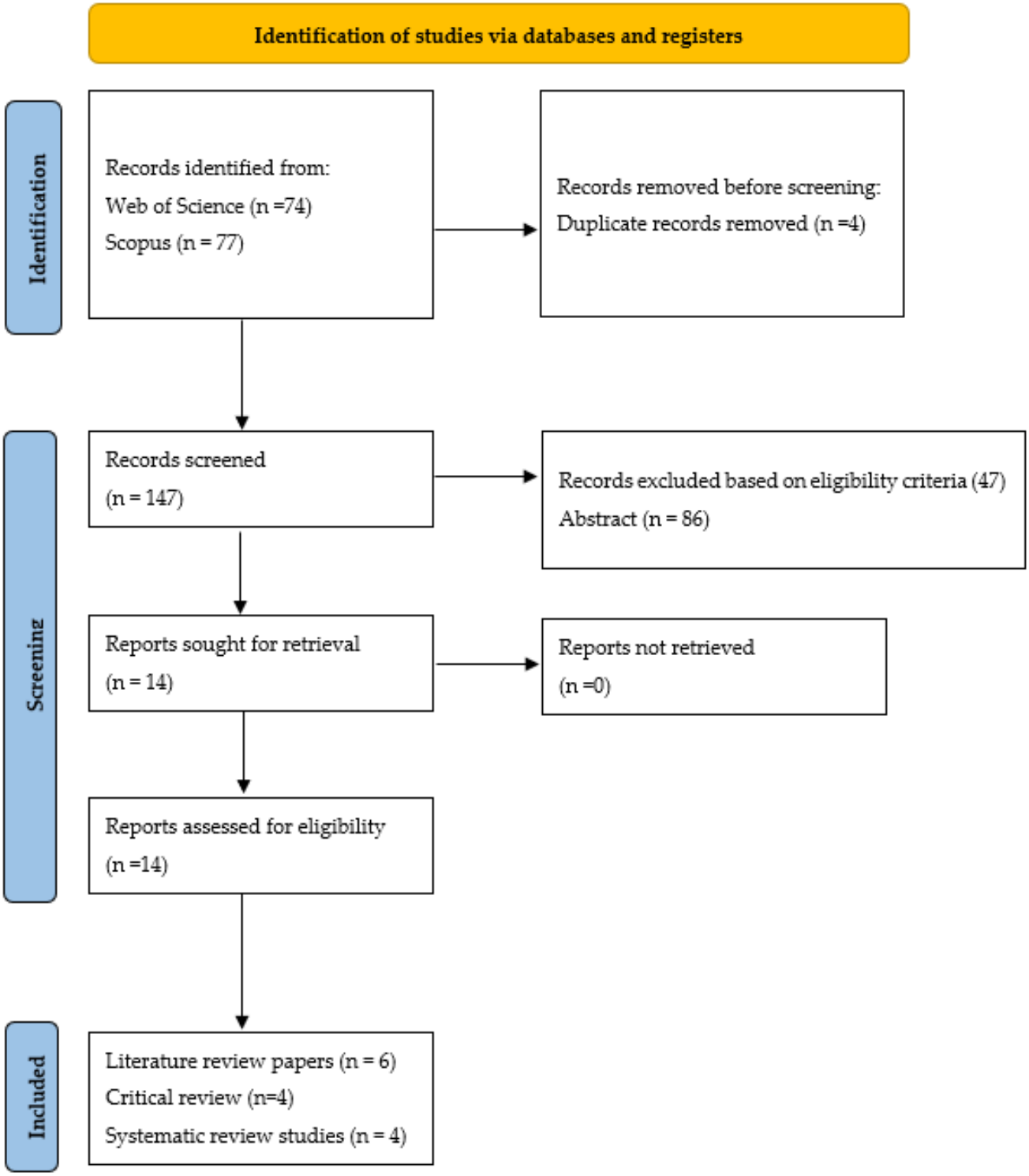

Figure 1. PRISMA flow chart of the literature search process.

The search yielded 151 publications, which were all manually screened to verify whether they focused on the topic of the TRN in higher education and whether they were correctly labelled as review papers. A final set of 14 review papers were used as the basis for the review of the reviews.

3.3. Screening and Selection

Relevant publications were exported to a Microsoft Excel spreadsheet reporting the title, abstract, keywords, authors' names, journal name, year of publication, language, and document type. This screening was carried out on the basis of inclusion and exclusion criteria, as listed in Table 1.

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Original research papers focusing on the framework of the TRN	The publication is out of scope of the TRN
Papers published between 2012 and 2022	Papers published outside the time window
Reported setting is University level.	Non-university educational context (elementary, high school, or unspecified)
Limited to English language	Written in a language other than English
Reported as review papers	Individual empirical TRN study (either qualitative and/or quantitative)
A full text is available for retrieval	Unavailable full text

An overview of the study of each record is summarized in Table 2.

Table 2. Type of review, year of publication, and country of origin.

Review Type	Authors
Narrative review	[12,16,26–29]
Critical review	[13,14,30,31]
Systematic review	[15,32–34]
Year of publication	
2012–2017	[14,15,26–29,31]
2018–2022	[12,15,16,30,32–34]
Country of origin of review	
UK	[12,13,16,19,30–32]
Australia	[14,26]
South Africa	[28]
Norway	[34]
Chile	[15]
Spain	[33]
Ireland	[29]

3.4. Data Analysis

In view of the findings obtained in response to the five research questions, the selection of publications was coded through a thematic analysis. Thematic analysis provides a flexible approach that results in a rich and detailed, yet complex account of data [35]. The thematic coding focused on five main themes central to the research questions: definition, benefits, challenges, strategies, and future directions. A 'theme' is considered as a lens by which to capture a perspective, and contributes to developing a level of patterned response or meaning within the dataset [36]. Although thematic analysis is very often presented as a six-step linear process [35,36], our data analysis approach was instead characterized as an iterative and reflective process, constantly moving backwards and forwards between

phases involving the first and the second author. In addition to thematic analysis, information was also collected regarding reported statistical effects. This is discussed separately in the results section. Analysis of quality was guaranteed by repeatedly reading through the data and re-checking the coding, and decisions were then discussed in the research group until agreement was reached between the first author and the second author.

4. Results

4.1. Descriptive Analysis and Review Quality Assessment

4.1.1. Review Types and Year of Publication

The set of fourteen review studies—published between 2012 and 2022—reflects methodological diversity. We identified ten non-systematic TRN review studies (traditional narrative reviews (N = 6) or critical reviews (N = 4)), and four systematic review papers. Grouping review types over time, narrative reviews were more dominant in the period between 2012 to 2017 [26–29]. From 2018 till 2022, systematic reviews became the prevailing review type [15,32–34].

Review studies originated from seven different countries and most reviews were mainly published by authors from the U.K. [12,13,16,19,30,32]. This could reveal stronger support, in a modern context, for the Humboldtian ideal of unifying teaching and research among English academics [12].

4.1.2. Teaching and Research Nexus: Review Aims and Questions

Over time, and by observing the aims or questions outlined in the review papers, we observed that only five studies (N = 5) explicitly reported or contained a review aim and review question; seven reported a general aim, and two did not provide review aims. Table 3 provides the details of the review aims and questions.

Table 3. Review aims and Questions.

Author	Review Aim	Review Questions
[26]	To advance understanding of the concept by exploring the literature that underpins it.	Not reported
[14]	To encourage new discourse on how higher education institutions can integrate research in discipline, scholarship of teaching (for and from), and teaching practice, by focusing on action needed to engage students in authentic learning to develop a broader range of knowledge and skills within, and across, disciplines.	Not reported
[27]	Addresses the knowledge gap by advocating a novel approach to research-informed teaching, which adopts a risk-management philosophy.	Not reported
[28]	Engage in a critical discussion of the relationship between teaching and research.	Not reported
[31]	A critical review of the literature around the constructed relationship often termed the 'research-teaching nexus'.	How, and how well, questions raised within the specific research have been addressed
[29]	To explore the conceptual and instrumental arguments for linking research and teaching.	Not reported
[13]	To provide a comprehensive account of how the idea of the TRM has developed and been applied.	Not reported
[30]	To explore the dominant agenda of research-led teaching excellence, centred on the idea of the productivity of research, and outline an alternative notion of teaching-led research, developed out of the work of Boyer and Walter Benjamin, within which teaching might continue, in spite of excellence.	Not reported

Table 3. *Cont.*

Author	Review Aim	Review Questions
[15]	To provide relevant evidence for university teachers, curriculum designers, and academic managers to decide what type of learning experiences they may organize for students.	Which type of experiences are most beneficial for science students to develop as scientists?
[32]	Systematic review of the literature to consider the implications of established and emergent themes and contested ideas from/for different perspectives.	• What, if any, is the impact of Exploratory Practice (EP) in terms of: (a) global reach; (b) global uptake; (c) implementation in different contexts (e.g., primary, secondary, tertiary education)? • What are the theoretical themes and insights emerging from the literature? • What are the (epistemological, methodological, pedagogical) affordances and/or constraints of enacting EP? • How do the conceptual and theoretical developments in EP relate to Applied Linguistics, Language Education, and beyond?
[33]	To establish how Inquiry-Based Learning (IBL) is used and what effects it has on university students from social sciences and health sciences.	• What are the origin, duration, and methodological characteristics of the studies? • What IBL mode do they use? • What type of objectives are set and what are the effects on the students? • What are the limitations of the studies analysed?
[34]	Not reported	Which barriers to students' active learning are identified in research on university campus development and technology use in higher education?
[12]	Not reported	How has the understanding of research shifted over time?
[16]	Outlines the argument that the pandemic has further exposed [the dysfunctions between the two core missions of a university—research and teaching].	• [What is the] impact on sectoral and institutional discrepancies between research and teaching? • How student and staff experience the link between research and teaching that changed during the pandemic? • What sort of university would serve its citizens and wider community better in a post-pandemic era?

As illustrated, the review studies provided a range of aims and research questions appropriate to the topic of TRN in higher education. While some critically discussed the relationship between teaching and research [28,29,34], others centred on providing empirical evidence or arguments to ground the nexus [13,15,29,33]. Some review studies advocated novel approaches [27], looked into particular effects [33], or centred on dysfunctions [16] of TRN in higher education. Overall, the review of the review studies helped to develop a very diverse picture of TRN as a field of study that is difficult to allocate to just one perspective or problem field. This seemed dependent on stakeholder perspectives and wider changes in the context of higher education (e.g., the COVID-19 pandemic).

4.1.3. Review Methods and Exclusion and Inclusion Criteria

Five reviews contained an explicit statement that the review methodology was defined prior to conducting the review [13,15,32–34], and nine failed to do so [12,14,16,26–31].

Only five reviews contained an explicit statement about inclusion/exclusion criteria [13,15,32–34], and, in nine reviews, this item was not applicable due to the review type, i.e., traditional narrative review or critical review [12,14,16,26–31].

4.1.4. Review Methodology Limitations and Declaration Statements

Thirteen reviews did not address review methodology limitations [12–16,26–32,34], except one that explicitly mentioned methodology limitations [33].

In eight reviews, the authors did not report potential sources of conflict of interest, including any funding they received for conducting the review [14,26–28,30–33].

4.1.5. TRN: Conceptualization, Benefits, Strategies, Challenges, and Future Directions

All reviews provided conceptualizations regarding TRN, benefits from different stakeholder perspectives, addressed strategies for TRN implementation, challenges, and future TRN directions. In general, the reviews reflected a detailed picture by which to tackle this research question; see summary in Table 4. We discuss this richness in relation to the following research questions.

Table 4. Quality assessment of the 14 reviews discussed.

Author	Quality Assessment Questions								
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**
[26]	No	Yes	NA	Yes	Yes	Yes	No	Yes	No
[14]	No	Yes	NA	Yes	Yes	Yes	No	Yes	No
[27]	No	Yes	NA	Yes	Yes	Yes	No	Yes	No
[28]	No	Yes	NA	Yes	Yes	Yes	No	Ye	No
[31]	No	Yes	NA	Yes	Yes	Yes	No	Yes	No
[29]	No	Yes	NA	Yes	Yes	Yes	No	Yes	Yes
[13]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
[30]	No	Yes	NA	Yes	Yes	Yes	No	Yes	No
[15]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
[32]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
[33]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
[34]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
[12]	No	Yes	NA	Yes	Yes	Yes	No	Yes	Yes
[16]	No	Yes	NA	Yes	Yes	Yes	No	Yes	Yes

Notes: Question 1: Did the report of the review contain an explicit description of the review methods applied? Question 2: Did the report of the review contain TRN conceptualization? Question 3: Did the report of the review contain an explicit statement that the review methods applied inclusion/exclusion criteria? Question 4: Did the review authors provide TRN benefits for different stakeholders? Question 5: Did the review authors provide strategies for implementing TRN? Question 6: Did the review authors provide challenges for implementing TRN? Question 7: Did the review authors provide a limitation of their review? Question 8: Did the review authors point out future directions on this topic? Question 9: Did the review authors provide a disclosure statement for conducting the review? NA: Not applicable.

4.2. What Are the Conceptual Approaches and Potential Changes in Concepts in the Reviews of TRN in Higher Education?

The Teaching Research Nexus was clearly conceptualized in all review studies. Three levels were distinguished in the conceptualisations:

(a) TRN as part of a long tradition to debate the nature or the idea of a university and/or higher education;
(b) TRN as a description of higher education teaching practices or pedagogy;
(c) TRN as a departing point to critically reflect on the mission of higher education.

These concepts are used to highlight the differences of at least three different traditions of debating the nature or the idea of university, namely, the English, the German, and the American higher education traditions. As previously mentioned, the English higher education tradition is anchored in the John Henry Newman idea of a university, the German tradition is closely connected to the Von Humboldt idea of a university, and the American tradition is associated with the Clark Kerr idea of a university. These traditions reflect the pre-Humboldtian, the Humboldtian, and the post-Humboldtian approaches [13,14,16,28,29]. In the pre-Humboldtian approach, teaching and research remain institutionally separated, even though links are created between extra-university research bodies and universities. In the Humboldtian approach, the two are funded from the same source and academics adopt both roles, and the organisation is stable. In the post-Humboldtian approach, there is an organisational movement towards differentiation in both roles, and in related funding structures and processes [16].

As a description of higher education teaching practices or pedagogy, the concept is used to distinguish modes of enhancing the quality of learning at the university level, during courses, and the classroom experience [13,15,27,30,32–34].

Further reflecting on the mission of higher education, review studies stress the pressures inflicted on universities due to social, economic, and political changes [12,13,30].

Three review studies conceptualized TRN while reflecting on its historical evolution, and stressed how the face of TRN has changed due to changes in the higher education context or in terms of global developments [12,30,31]. The concept was used to chart the historical transformation of higher education from the legacy of the British 'colonial college' to the dominance of the German research university [30], or to articulate the gradual swing of the pendulum from one extreme to the other [12]. The nature of how understandings of TRN have shifted over time form the focus of these review papers by drawing on historical literature to explore these changes.

4.3. What Are the Benefits of an Experimental TRN Intervention as Perceived by Academics and Students?

Data analysis helped to summarise the reported benefits of experimental TRN interventions. While some benefits were related to student processes and variables, others were related to academics. All review papers presented student-related benefits. Some review papers (N = 8) provided benefits related to both students and academics [13,14,26–31]. Student-related benefits were linked to: (i) the development of high-level competencies (such as problem formulation, data analysis, writing, collaboration, and critical thinking); (ii) student cognitions; (iii) research competences; and (iv) personal and discipline-oriented skills. Academic-related benefits were linked to: (i) the teaching process; (ii) pedagogical skills; and (iv) opportunities to refresh knowledge. Table 5 provides a detailed overview of the reported benefits of experimental TRN interventions in higher education.

4.4. What Concrete Implementation TRN Strategies Are Discussed by TRN Reviews?

Review studies on the teaching-research nexus offered a large variety of TRN strategies. These placed considerable emphasis on student participation and/or considered how academics use their own pedagogic research to inform teaching.

A range of concepts were used to describe TRN implementation strategies: as a framework [14,29], a model [12–14,16,26,28,29,33,34], a form or approach [14,15], or as a list of recommendations [13,26–28] situated within contexts ranging from a discipline, a department, and an institution in a small-scale or large-scale project involving undergraduate and/or postgraduate students. Table 6 presents the details of review strategies of the TRN in higher education.

Table 5. Benefits of an experimental TRN intervention.

	TRN Benefits	
Authors	**Student-Related Benefits**	**Academic-Related Benefits**
[30]	Development independence of thought, entrepreneurial and transferable skills, and the ability to handle uncertainty and new problems central to rapidly evolving workplaces of the knowledge-economy.	Restructuring both the pedagogical and the integrative aspects of the research university experience to make research-based learning the standard.
[29]	Enhanced knowledge and expertise for all; intrinsic knowledge-creation and problem-solving value; enhance faculty expertise, communication skills, and methodological awareness, enriching pedagogical quality; empowering and enthusing students; strengthening bonds between educators and students, generating new research ideas, and providing insights into what researchers do.	Linking research and teaching is perceived to lead to enhanced knowledge and expertise for all; enhancing academic credibility; strengthening bonds between educators and students, generating new research ideas, and providing insights into what researchers do.
[28]	It contributes to improved teaching effectiveness, improves student learning outcomes, and may ultimately change academic cultures and communities.	It contributes to improved teaching effectiveness, and may change academic cultures and communities.
[14]	Students develop the broad range of knowledge and skills required for them to make effective contributions within, and across, disciplines.	An alternative to the current divisive approach to viewing research and teaching as non-integrated, competing components of higher education.
[26]	Positive perceptions of the value of staff research for student learning. Students gained tangible benefits from staff research, mainly through students perceiving that their courses were current and intellectually stimulating.	Teaching and research roles as mutually supportive.
[16]	Supports students "to think critically, to analyse problems, and to make decisions in the face of complex knowledge".	Not reported
[27]	Empowering and enthusing students; strengthening bonds between educators and students; generating new research ideas and providing insights into what researchers do.	Enhancing academic credibility. Strengthening bonds between educators and students; generating new research ideas and providing insights into what researchers do.
[31]	Development of graduate attributes and graduate outcomes; intellectual and attitudinal development of learners; sustains an actionable link between graduate employability and the challenges of (. . .) super-complex society.	Curriculum construction.
[15]	Positive effects on students.	Not reported
[12]	The student learns the ability to question received wisdom as the distinguishing feature of higher education.	Not reported
[32]	Student (and teacher) motivation levels increased.	Not reported
[33]	Promotes active learning with positive effects on students' achievements and their attitudes towards research; stimulates their problem-solving capacity, critical thinking, and reflection on learning; fosters university students' research competence and training, improving the quality of what they learn and the process of peer collaboration; promotes better understanding of subjects among students; increases their academic writing skills.	Not reported
[34]	To promote student active learning.	Not reported
[13]	Student attitudes revealed to be generally positive, with students appreciating being taught by academics who are actively engaged in researching their subject.	Students appreciating being taught by academics who are actively engaged in researching their subject.

Table 6. Strategies of TRN in higher education.

Strategies of TRN in Higher Education	
Framework	**Authors**
Research Skill Development (RSD) framework	[29]
The Scholarship-Teaching-Action-Research (STAR) framework	[14]
Scholarly and Research Activity (SandRA)	
scholarship-teaching-action-research framework	[13]
Models	
Research-tutored Research-based Research-led Research-oriented	[12–14,16,26,28,29,33,34]
Teaching-led research Teaching-based research Teaching-informed research Teaching-led research	[30]
Forms	
Undergraduate Research and Research-Based Courses	[15]
Communities of Practice	[14]
Situated learning	
Descriptive approaches or recommendations	
Drawing on personal research in designing and teaching courses. Placing the latest research in the field within its historical context in classroom teaching. Designing learning activities around contemporary research issues. Teaching research methods, techniques, and skills explicitly within subjects. Building small-scale research activities into undergraduate assignments. Involving students in departmental research projects. Encouraging students to feel part of the research culture of departments. Infusing teaching with the values of researchers. Conducting and drawing on research into student learning to make evidence-based decisions about teaching. Research findings are disseminated in lectures and tutorials. Having students carry out research or be involved in discussions about the ideas. Having students (especially postgraduates) engage in research that is relevant to their professional and academic interests. Students and teachers engaging in collaborative research. Faculty level, inquiry/problem based. Sufficient time for students to undertake projects and assignments that are research or industry related. Build up from inquiry/problem-based approaches and teaching of research-related skills in earlier courses. Developing institutional awareness and institutional mission. Developing pedagogy and curricula to support the nexus. Developing research policies and strategies to support the nexus. Developing staff and university structures to support the nexus. Improving understanding of research-informed teaching within the discipline. Better guidance and support from the institution and higher education community on implementation Reflection on policies, culture, practices, and values to identify gaps in delivery processes. Strong leadership to maintain equal quality in teaching and research, as well as increasing confidence within teaching. Support for individual academics, including reward systems that recognize and encourage a 'step-change toward more research-informed teaching'. Improving understanding of research-informed teaching within the discipline. Scholarship and consultancy.	[13,26–28]

4.5. What Are the Perceived Challenges as to the Implementation of the Teaching and Research Nexus (TRN) in Higher Education?

Considering the variation of implementation strategies, all TRN review studies uncovered many challenges in higher education. These challenges were related to students, academics, institutions, and policies. The same issues were sometimes described as risks [27] or barriers [32,34]. The most comprehensive review reporting a detailed overview of challenges was in [27]. This review adopted a risk management approach to identify (a) intrinsic, (b) extrinsic, and (c) learning risks.

Most review papers (N = 12) focused on intrinsic risks. This included risks that lay within the actual teaching practices, such as those emanating from curriculum design, lesson planning, delivery in the classroom, and quality of the teaching. Some review papers (N = 5) paid attention to extrinsic risks. These were related to impacts on the teacher from outside the teaching process (institutional policies, government directives, and economic climate). Particular challenges involved the changing nature of academic work and how teachers were influenced by the tension between involvement in teaching and/or research. The latter was often linked to management and funding issues. A smaller number of reviews (N = 5) tackled learning risks or risks identified from the student perspective; for example, when research engagement impacts students' overall learning experience, or when individual students struggle to cope with additional demands of the research-based learning method. Table 7 provides a detailed overview of the reported TRN challenges in higher education.

4.6. What Are the Future Directions of TRN in Higher Education?

Review studies provided interesting future directions for TRN. These did not reflect a return to the so-called 'golden age of academe' [12], but mainly showed how TRN is influenced by very actual and urgent global challenges, such as environmental destruction, climate change, conflict, and socio-economic inequities [16].

Only one review directed attention to the methodology being used [15]. Some reviews (N = 3) addressed future directions at the conceptual level or frameworks being used [12,26,27]. Others (N = 4) dealt with future practices or pedagogy to implement TRN [13,16,32,33]. Most reviews (N = 5) stressed future directions at the institutional and policy level [13,16,27,31,34]. Table 8 summarizes these in more detail.

4.7. Reported Statistical Effects in the Review Studies

As described in the discussion of review results above (see Section 4.3; What are the benefits of an experimental TRN intervention as perceived by academics and students?), all review papers provided evidence about student-related benefits, and some review papers (N = 8) put forward benefits related to both students and academics. The availability of statistical data from these review papers is necessary to explicitly consider results from comparable prior research, thus allowing the aggregation of this statistical body of knowledge at a higher level of analysis, interpretation, and conclusion [37]. This is critical for a topic where debate often creates controversies and involves multiple university stakeholders with divergent interests [8]. It also seems crucial in the case of the TRN, since the actual evidence base remains unclear [9]. This is partly due to the fact that teaching and research are often loosely coupled, while being deeply nested within very different organizational structures [38]. Therefore, descriptive discussions are hard to generalize across contexts. In contrast, relying on statistical data could make a difference [38]. It is widely recognized that the proper use of statistics is a key element of research integrity [39] and scholars have provided guidelines for experimental [40] and quasi-experimental designs [39], as well as appropriate statistical procedures to back empirical evidence [37,39–42].

Surprisingly, only two review papers reported statistical effects of TRN interventions on students. Indeed, one [33] used descriptive statistics to report the percentage of studies reporting the effect of TRN on: (i) students' improved understanding of subjects and of their relevance to society; (ii) increased collaboration between students when working together

to achieve a common goal; (iii) an increase in joint responsibility in carrying out tasks; and (iv) improved interpersonal skills and skills in performing work roles. Furthermore, the second [15] reported p-values related to positive effects on: (i) students' understanding of the natures of research work; (ii) professional practice; (iii) attitude and behaviour for practicing science; (iv) interest in science; (v) career options; and (vi) students' confidence level while being engaged in research-based courses and undergraduate research programs. Basic descriptive statistics alone are insufficient to carry out a higher-level of statistical analysis. Therefore, a higher level statistical meta-analysis of the review studies could not be carried out.

Table 7. Challenges of TRN in higher education.

Challenges	Authors
Intrinsic Challenges:	
A facilitative, responsive andragogy, a broad repertoire of academic knowledge and theories, as well as familiarity with a range of research approaches. Academics' ability to integrate research and teaching. Balance practical advantages of research-based courses with the more intense undergraduate research experiences. Conflicting time pressures upon [academics] to increase research outputs at the same time as improving the quality of teaching. Curriculum and instruction vs professional experience. Disciplinary or departmental culture. Formal evaluation. Increasingly diverse and demanding student body. Individual academics' perceptions of the teaching research nexus and the development their own academic identity. Modelling research-teaching linkages. Research-based courses and undergraduate research programs meet minimum standards for qualifying as research. Teaching tradition in higher education. The massification of contemporary higher education The research intensiveness of the institution Volume of students	[13–16,26,28–34]
Extrinsic challenges:	
Change in the nature of academic work. Clear demarcation between research- and teaching-focused institutions. Existing vulnerabilities across the system. Limitations derived from the university structures. Managements approaches. National research funding policies. Rankings and institutional priorities and practices regarding Teaching and Research. Renewal of a long-standing debate over the relative value of discipline-based research. Teaching as practice and scholarship of teaching. Sectoral and institutional inequalities of research funding. Stratified university system. University's societal role.	[14–16,26,29,33]
Learning challenges:	
Feelings of alienation and abandonment. Inequalities of access and progression in higher education in general and research in particular Mass participation means not everyone can do research. Students may resist their introduction to new ways of teaching. Students remain recipients of research or become unpaid research assistants.	[14,16,26,33]

Table 8. Future directions of TRN in higher education.

Future directions of TRN in Higher Education	Authors
Conceptual level or Framework	
Future research should address formal evaluation of these approaches and direct comparisons with traditional approaches. Further empirical research to test the broader veracity of the framework. Re-establish the spirit of research and value the way in which research awareness, rather than research productivity per se, can enrich university-level teaching with a critical, research-informed perspective.	[12,14,26]
Methodological approach	
Data collection at different times during the development of experiences (e.g., prepost) to establish whether they influenced students or not, with a benchmark (pretest). Use of a comparison group (e.g., research-based courses versus traditional courses). Inclusion of longitudinal studies for determining whether the effects of student participation in the various types of research experiences are maintained over time after they have finished. Use of statistical analysis, in the case of quantitative studies, that make some comparison (e.g., prepost) to determine whether achievement levels perceived by students are different from each other.	[15]
Practice or Pedagogy	
Cover other fields of knowledge and educational stages. Renew the ways of thinking and working together within and across disciplines and fields. Further surfacing of hitherto hidden links and connections across disciplines, with acknowledgement of the potency of practitioners.	[13,16,32,33]
Institutional Policy and Management	
Build a system that is more equitable and inclusive to both students and staff, more flexible in its organization, strongly rooted in its wider community, less obsessed with competition, and much more collaborative in nature. An integrated infrastructure for research and teaching in higher education institutions will support research-based teaching as this requires systematic, continuous development of teaching practices and will open a scholarly approach to teaching. [Detailed research] in the relation between policy—at international, national, institutional, or departmental level—and practice at the micro-level, where academics and their students, [engage in both teaching and research]. Providing a sector-wide perspective of the risks involved in [TRN] and how to effectively manage them. [Re-address] the questions of baseline quality, policy, outcomes, and value [of TRN in Higher Education].	[13,16,27,31,34]

5. Discussion and Conclusions

This systematic review of reviews provides an overview of the TRN in higher education based on literature searches conducted in the August 2022. It reveals that the available review studies allow us to answer key questions concerning the conceptual bases and the evolution in definitions of TRN. The benefits, as perceived by academics and students, types of TRN challenges, and a range of instructional strategies can be used guide its implementation in higher education. Lastly, a structured overview of future directions of TRN could be further developed. However, the review also pointed out a lack of statistical rigour in the reporting of studies. This implied that no meta-analysis could be carried out.

The present review highlighted a methodologically diverse picture in terms of conducting reviews, considering the gradual increase in the adoption of a systematic approach in recent years. The latter meets the growing demand to pursue statistical rigour and move away from non-systematic reviews [43]. The growing adoption of systematic reviews follows growing trends in review research in other domains; e.g., review studies regarding hospitality and tourism [23], social protection [44], as well as in gerontology and health services [45].

As demonstrated in this paper, available review studies largely differed in their methodological approach because of a focus on multiple university stakeholders with diverging interests [8], and often resulted in a very wide overview which was unclear on the value of the TRN [9].

The current study helped by comparing and contrasting review studies, and by developing a structured state-of-the-art approach. This study revealed that a conceptual analysis of TRN highlighted variations in traditions of debating the nature or the idea of universities. On the other hand, it can be used as a description of higher education teaching practices or pedagogy to distinguish modes of improving the quality of learning at the university level, during courses, and the classroom experience. Moreover, the TRN is helpful as a starting point to reflect on the mission of higher education in the context of current social, economic, and political changes. Similarly, there has been agreement among scholars regarding the benefits of (experimental) TRN intervention. These are related to student learning outcomes and the development of a wide range of competences that go beyond graduation. Outcomes for academics are related to their teaching and research practices, but also reflect a meso-level impact on curricula and academic culture. When it comes to the question regarding TRN strategies, the review findings placed considerable emphasis on student participation and/or a consideration of how academics use their own pedagogic research to inform teaching. However, all of the TRN higher education review studies also uncovered intrinsic and extrinsic challenges related to students, academics, institutions, and educational policies. Combining research and teaching seems to stretch resources (time, expertise, funding), demands (priorities), and policies (role of university teaching and learning). Future directions for TRN in higher education included incorporating conceptual questions, methodological recommendations, TRN practices, and TRN-related policy developments.

6. Limitations and Future Research

This systematic review has some limitations. First, some available review studies could not be included in our study based on the inclusion/exclusion criteria. The studies could nevertheless have added to the richness of the data already described above. Precision is required when analysing peer-reviewed research, and analysis of non-English, non-peer reviewed, or excluded studies or reports (such as those found via Google scholar) could help in confirm the present picture of the status of the TRN in higher education or add elements or dimensions not yet identified. Nevertheless, the current analysis could serve as a benchmark for future review studies.

The second limitation is related to the methodological diversity of review studies included in the present systematic review. As reported, between 2012 and 2022, six were classified as traditional narrative reviews, four as critical reviews, and another four as systematic review papers. This might raise the question concerning the level of comprehensiveness or balance in the present analysis. Themes identified through systematic analysis were not 'quantified' and could not be studied as to their importance in the TRN debate. In addition, the diversity in TRN research involving very different samples also makes analysis and synthesis difficult. A next-level analysis could be adopted to reanalyse the studies incorporated in the review studies.

Despite these limitations, the findings of the present review helps develop an initial benchmark regarding the status of reviews on the TRN in higher education. It can inform researchers and teachers about the broader nature of TRN, and might inspire other researchers, teachers, and policy-makers to consider the broader picture. This can be achieved against a background of the changing nature of higher education considering the changing demands of society. In the post-COVID period, a stronger emphasis on the societal relevance of higher education can inspire universities to reflect on their own policies and practices, and define how teaching and research are mutually beneficial in supporting the graduation of alumni that fit into the framework of a future-oriented (global) society.

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References

1. Mok, K.H. Higher Education Transformations for Global Competitiveness: Policy Responses, Social Consequences and Impact on the Academic Profession in Asia. *High. Educ. Policy* **2015**, *28*, 1–15. [CrossRef]
2. Mok, K.H.; Jiang, J. Massification of higher education and challenges for graduate employment and social mobility: East Asian experiences and sociological reflections. *Int. J. Educ. Dev.* **2018**, *63*, 44–51. [CrossRef]
3. Mok, K.H.; Marginson, S. Massification, diversification and internationalisation of higher education in China: Critical reflections of developments in the last two decades. *Int. J. Educ. Dev.* **2021**, *84*, 102405. [CrossRef]
4. Sawyerr, A. Challenges Facing African Universities: Selected Issues. *Afr. Stud. Rev.* **2014**, *47*, 1–59. [CrossRef]
5. Elsen, M.; Visser-Wijnveen, G.J.; van der Rijst, R.M.; van Driel, J.H. How to strengthen the connection between research and teaching in Undergraduate University Education. *High Educ. Q.* **2009**, *63*, 64–85. [CrossRef]
6. Locke, W. Integrating Research and Teaching Strategies: Implications for Institutional Management and Leadership in the United Kingdom. *High. Educ. Manag. Policy* **2005**, *16*, 101–120. [CrossRef]
7. Verburgh, A.; Elen, J.; Lindblom-Ylänne, S. Investigating the myth of the relationship between teaching and research in higher education: A review of empirical research. *Stud. Philos. Educ.* **2007**, *26*, 449–465. [CrossRef]
8. De Witte, K.; Rogge, N.; Cherchye, L.; Van Puyenbroeck, T. Economies of scope in research and teaching: A non-parametric investigation. *Omega* **2013**, *41*, 305–314. [CrossRef]
9. McKinley, J.; McIntosh, S.; Milligan, L.; Mikołajewska, A. Eyes on the enterprise: Problematising the concept of a teaching-research nexus in UK higher education. *High. Educ.* **2021**, *81*, 1023–1041. [CrossRef]
10. Petticrew, M.; Roberts, H. *Systematic Reviews in the Social Sciences: A Practical Guide*; John Wiley & Sons: Hoboken, NJ, USA, 2008; pp. 1–336.
11. Zhang, L.; Shin, J.C. The research-teaching nexus among academics from 15 institutions in Beijing, Mainland China. *High Educ.* **2015**, *70*, 375–394. [CrossRef]
12. Macfarlane, B. The spirit of research. *Oxf. Rev. Educ.* **2021**, *47*, 737–751. [CrossRef]
13. Tight, M. Examining the research/teaching nexus. *Eur. J. High. Educ.* **2016**, *6*, 293–311. [CrossRef]
14. Jones, S. Beyond the teaching-research nexus: The Scholarship-Teaching-Action-Research (STAR) conceptual framework. *High. Educ. Res. Dev.* **2013**, *32*, 381–391. [CrossRef]
15. Olivares-Donoso, R.; González, C. Undergraduate Research or Research-Based Courses: Which Is Most Beneficial for Science Students? *Res. Sci. Educ.* **2019**, *49*, 91–107. [CrossRef]
16. Hordósy, R.; McLean, M. The future of the research and teaching nexus in a post-pandemic world. *Educ. Rev.* **2022**, *74*, 378–401. [CrossRef]
17. Hattie, J.; Marsh, H.W. The relationship between research and teaching: A meta analysis. *Rev. Educ. Res.* **1996**, *66*, 507–542. [CrossRef]
18. Henkel, M. Teaching and Research: The Idea of a Nexus. *High. Educ. Manag. Policy* **2004**, *16*, 19–30. [CrossRef]
19. Zaman, M.Q.U. *Review of the Academic Evidence on the Relationship between Teaching and Research in Higher Education*; Department for Education and Skills: London, UK, 2004; pp. 1–122.
20. Jusoh, R.; Abidin, Z.Z. The Teaching-Research Nexus: A Study on the Students' Awareness, Experiences and Perceptions of Research. *Procedia Soc. Behav. Sci.* **2012**, *38*, 141–148. [CrossRef]
21. Halliwell, J. *The Nexus of Teaching and Evidence and Insights from the Literature*; Higher Education Quality Council of Ontario: Toronto, ON, Canada, 2008.
22. Trowler, P.; Wareham, T. Re-conceptualising the "teaching-research nexus". In *Higher Education Research and Development*; Higher Education Research and Development Society of Australasia: Adelaide, Australia, 2007.
23. Kim, C.S.; Bai, B.H.; Kim, P.B.; Chon, K. Review of reviews: A systematic analysis of review papers in the hospitality and tourism literature. *Int. J. Hosp. Manag.* **2018**, *70*, 49–58. [CrossRef]
24. Grant, M.J.; Booth, A. A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Inf. Libr. J.* **2009**, *26*, 91–108. [CrossRef]
25. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Syst. Rev.* **2021**, *88*, 105906.
26. McGill, T.; Armarego, J.; Koppi, T. The Teaching–Research–Industry–Learning Nexus in Information and Communications Technology. *ACM Trans. Comput. Educ.* **2012**, *12*, 1–20. [CrossRef]
27. Gresty, K.A.; Pan, W.; Heffernan, T.; Edwards-Jones, A. Research-informed teaching from a risk perspective. *Teach. High. Educ.* **2013**, *18*, 570–585. [CrossRef]

28. Toni, N.; Maphosa, C.; Wadesango, N. Promoting the Interplay between Teaching and Research in the University and the Role of the Academic Developer. *Mediterr. J. Soc. Sci.* **2014**, *5*, 19. [CrossRef]
29. Quinn, B.C. Teaching and research in mid-career management education: Function and fusion. *Teach. Public Adm.* **2016**, *34*, 7–18. [CrossRef]
30. Charles, M. Teaching, in Spite of Excellence: Recovering a Practice of Teaching-Led Research. *Stud. Philos. Educ.* **2018**, *37*, 15–29. [CrossRef]
31. Malcolm, M. A critical evaluation of recent progress in understanding the role of the research-teaching link in higher education. *High. Educ.* **2014**, *67*, 289–301. [CrossRef]
32. Hanks, J. From research-as-practice to exploratory practice-as-research in language teaching and beyond. *Lang. Teach.* **2019**, *52*, 143–187. [CrossRef]
33. Santana-Vega, L.E.; Suárez-Perdomo, A.; Feliciano-García, L. Inquiry-based learning in the university context: A systematic review. *Rev. Esp. Pedagog.* **2020**, *78*, 519–537.
34. Børte, K.; Nesje, K.; Lillejord, S. Barriers to student active learning in higher education. *Teach. High. Educ.* **2020**. [CrossRef]
35. Nowell, L.S.; Norris, J.M.; White, D.E.; Moules, N.J. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *Int. J. Qual. Methods* **2017**, *16*, 1609406917733847. [CrossRef]
36. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2008**, *3*, 77–101. [CrossRef]
37. König, C.; van de Schoot, R. Bayesian statistics in educational research: A look at the current state of affairs. *Educ. Rev.* **2018**, *70*, 486–509. [CrossRef]
38. Labaree, D.F. The lure of statistics for educational researchers. *Educ. Theory* **2011**, *61*, 621–632. [CrossRef]
39. Kim, Y.; Steiner, P. Quasi-Experimental Designs for Causal Inference. *Educ. Psychol.* **2016**, *51*, 395–405. [CrossRef] [PubMed]
40. Zendler, A.; Vogel, M.; Spannagel, C. Useful experimental designs and rank order statistics in educational research. *Int. J. Res. Stud. Educ.* **2012**, *2*, 83–106. [CrossRef]
41. Resnik, D.B. Statistics, ethics, and research: An agenda for education and reform. *Account. Res.* **2000**, *8*, 163–188. [CrossRef]
42. Gibbs, B.G.; Shafer, K.; Miles, A. Inferential statistics and the use of administrative data in US educational research. *Int. J. Res. Method Educ.* **2017**, *40*, 214–220. [CrossRef]
43. Pickering, C.; Byrne, J. The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers. *High. Educ. Res. Dev.* **2014**, *33*, 534–548. [CrossRef]
44. Perera, C.; Bakrania, S.; Ipince, A.; Nesbitt-Ahmed, Z.; Obasola, O.; Richardson, D.; Van de Scheur, J.; Yu, R. Impact of social protection on gender equality in low- and middle-income countries: A systematic review of reviews. *Campbell Syst. Rev.* **2022**, *18*, e1240. [CrossRef]
45. Chen, M.; Dutt, A.S.; Nair, R. Systematic review of reviews on Activities of Daily Living measures for children with developmental disabilities. *Heliyon* **2022**, *8*, e09698. [CrossRef] [PubMed]

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Does Interdisciplinary Research Lead to Higher Faculty Performance? Evidence from an Accelerated Research University in China

Li Yu [1,*,†], Yue Yan [2,†] and Mingjun Li [3]

[1] Center for Higher Education Research, Southern University of Science and Technology, Shenzhen 518055, China
[2] Business School of Zhangjiagang Campus, Jiangsu University of Science and Technology, Zhenjiang 215600, China
[3] Institute of Public Policy, South China University of Technology, Guangzhou 510641, China
* Correspondence: ppyul@scut.edu.cn
† These authors have contributed equally to this work and share first authorship.

Abstract: The current trend of building accelerated research universities in China that explore the pursuit of interdisciplinary research (IDR) approach to yield academic excellence and innovation through institutional reforms is aspiring to achieve the Sustainable Development Goals (SDGs). Employing data from faculty Curriculum Vitae and bibliometric records from a pilot accelerated research university in China, this study provides a case study to empirically quantify the impact of interdisciplinary research on 490 faculty's performance, including research productivity, impact, and prestige. Results show that faculty involved in interdisciplinary research outperform their non-interdisciplinary counterparts in terms of research productivity, impact, and prestige. The degree of interdisciplinary as measured by subject categories is positively associated with faculty research performance. However, there are heterogeneous effects across faculty subgroups since faculty in applied-oriented disciplines reap more benefits while young faculty may suffer. Additionally, this study finds that faculty individual interdisciplinary research behavior can be affected by school-level concentration and dispersion of the degree of interdisciplinarity, which suggests the existence of peer effects.

Keywords: interdisciplinary research (IDR); accelerated research university; research collaboration; faculty performance

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1. Introduction

UN Sustainable Development Goals (SDGs) are used to guide the global development work from 2015–2030 to better solve global problems, such as poverty eradication, inequality reduction, and climate change and impacts. Within a single discipline, it is impossible to solve the practical problem [1]. Many sustainability-related topics, including sustainable city system study [2], sustainable regulated river management [3], sustainable education, environments, and business management [4], frequently adopt an interdisciplinary research approach because of complexities, ambiguities, and dynamic exchanges of these topics [5]. In addition, scientific research is driven by people. Some of the most influential scientists driving SDG research are conducting interdisciplinary research scattered across disciplines.

According to SDGs, the ninth item specifically indicates that industry, innovation, infrastructure, and investment in infrastructure and innovation are crucial drivers of economic growth and development. In addition, the role of Education for Sustainable Development (ESD) for SDGs is highlighted in the fourth item [6], and universities are at the forefront of driving ESD and are always innovating [7]. With over half the world population now living in cities, mass transport and renewable energy are becoming ever more

important due to the growth of new industries and information and communication technologies. Technological progress is also key to finding lasting solutions to both economic and environmental challenges, such as providing new jobs and promoting energy efficiency. Promoting sustainable industries and investing in scientific research and innovation are all important ways to facilitate sustainable development. Scientific excellence plays a key role in introducing and promoting innovation and new technologies, and innovation and technological progress are essential to find lasting solutions to global challenges and can unleash dynamic and competitive economic forces that ensure sustainable development. Given the assumption underlying the policies is that interdisciplinary research crosses the boundaries between different fields of study to introduce unconventional, innovative approaches and scientific inventions, it is crucial to foster sustainable innovation and entrepreneurship through interdisciplinary research.

In the view of scientists, policymakers, and fund providers, interdisciplinary research is of great significance and plays a great role in generating "breakthrough" research results. There are two main advantages to support interdisciplinary research compared to standard disciplinary research. First, it has been argued that interdisciplinary research can not only solve the issues and difficulties brought by the complexity of research, but also mobilize the knowledge stock of each involved academic field. Second, the major discoveries and innovations in modern science often depend on the knowledge exchange and mutual penetration of multiple disciplines. The intersection of different disciplines is often the growth point and scientific frontier of new disciplines and is most likely to produce major scientific discoveries. Since the mid-1980s, more and more papers in the international academic circle began to cite papers outside their field. The Nobel Prize winners were able to discover the impact of interdisciplinarity, such as Shechtman's 1984 paper [8], which had a largely interdisciplinary impact, being cited significantly by papers from physics, engineering, and chemistry (its field of award) [9]. Due to the unique cutting-edge and innovation potential of interdisciplinary research, governments and funding institutions around the world have paid great attention to and supported interdisciplinary science projects in recent years. For example, it has increasingly become an important dimension taken into account in public funding processes both in the EU framework and US NSF funding programs. In 2020, the National Natural Science Foundation of China (NSFC) established the department of interdisciplinary science to plan and guide research at the scientific frontier and interdisciplinary fields to meet the major national strategic needs.

One common trend and important development strategy of world-class universities is promoting interdisciplinary research. In recent years, with the implementation of the "first-class university and first-class discipline" construction of colleges and universities in China, more attention has been paid to interdisciplinary research at the national policy level. The policies on further promoting the construction of world-class universities and first-class disciplines put forward that colleges and universities should optimize the layout of disciplines, break the barriers between conventional disciplines, highlight the cross integration and collaborative innovation of disciplines, and vigorously encourage high-quality cooperation across universities, institutions, and disciplines. However, the breadth and depth of interdisciplinary research in colleges and universities in China are still very limited and face multiple obstacles and constraints. For a long time, scientific research activities in Chinese universities are mainly carried out within colleges and research organizations that are usually established based on a single discipline. The research fields of these colleges or organizations are highly concentrated, focusing on certain research directions under a single discipline. The colleges and organizations dominated by a single discipline usually fail to carry out interdisciplinary research by themselves since they face strict organizational barriers among disciplines that makes them difficult to make interdisciplinary exchanges and cooperation effectively. Furthermore, these organizational arrangements restrict the integration of multidisciplinary research resources and make it harder for scholars to have a sense of identity and belonging.

2. Institutional Background

Under the national strategies for innovation-driven development, our sampled university (University S) is a newly established accelerated research university that focuses on science, technology and medicine and is supplemented with business and humanities and social science disciplines in China. Since its inception in 2011, University S has always adhered to the development principle of pursuing small and strong, rather than large and comprehensive disciplines. The university focuses on developing basic disciplines such as mathematics, physics, chemistry, and mechanics with its own characteristics and advantages and offers interdisciplinary pedagogy to cultivate well-rounded college graduates with innovative thinking. With rapid development, it achieved outstanding research ratings in the research assessment and was ranked as the top 10 Chinese universities in Times Higher Education's Young University Rankings 2020.

Taking the entirely new University S as a representative of accelerated research universities in China, several pilot reforms were implemented to promote interdisciplinary research: first, it urges colleges to break down the barriers of departments and majors, let prominent scientists worldwide take leading roles, and build joint research teams with cooperation across departments to tackle major scientific problems and core technologies given that a single discipline can barely achieve the goals. The university attracted a number of world-class scientists through international forums and other large-scale international academic conferences to join the academy, exploring a new mode of talent invitation through special exchange and visit funds, and inviting professors on sabbatical leave to establish a close link with universities and laboratories at the frontier science. The university has also strengthened the construction of large teams based on the PI (principal investigator) system in which top scholars are allowed to lead the formation of large teams and gather multidisciplinary researchers to cooperate according to the needs, to solve the problems of self-research and weak adaptation to deal with big technical problems. The PI system is allowed to hire research-track professors and postdocs with funding jointly bore by the research team and university.

Second, the university emphasizes building scientific research platforms and centers that foster interdisciplinary research. Take the Academy for Advanced Interdisciplinary Studies (hereinafter referred to as the Academy) for example, it is committed to promoting the cross integration of frontier science exploration and research to a high degree. Guided by major scientific problems, the academy actively integrates the advantages of different professional disciplines, gathers talents in multiple fields, builds a large-scale shared experimental platform, provides a place for ideological collision, breaks through major scientific and technological problems that are difficult to be solved by a single discipline, and takes this opportunity to explore the mechanism and methods of discipline integration and new growth points, to create a high-end academic ecology. Established in 2016, it is the management organization of the university's cutting-edge cross-scientific research center. By organizing researchers from different disciplines and professional backgrounds to carry out collaborative research, innovate systems, and mechanisms, the Academy focuses on major scientific research directions, crosses discipline boundaries, realize thinking collision and technology sharing among disciplines, and actively promotes the cutting-edge scientific development and advanced technological innovation. In addition, the university has set up joint laboratories with leading enterprises in the local community through the "dual employment system" to strengthen university–industry collaboration and talent cultivation.

Third, University S is carrying out a large-scale faculty evaluation reform to extend the term of evaluation and split the contributions within research teams. For one thing, major scientific research tasks can hardly be completed in two or three years. It may take five to 10 years or more, and it requires multiple teams to work together. Therefore, universities should not adopt the short-term evaluation method for the team of jointly tackling major projects, nor the traditional method of evaluating the department of the team separately. Colleges and universities should strive to guide researchers and research teams to carry out long-term research according to the nature of science. Furthermore, it adopts different

evaluation methods of scientific research achievements with different emphases to build a long-term evaluation mechanism for basic and applied scientific research according to the characteristics of different disciplines. The university does not take the number of articles as the key evaluation standard, but gradually and comprehensively implements the representative work evaluation system. The system focuses on international peer evaluation, academic contribution and academic influence, and transformation of intellectual property achievements. At the same time, University S strives to improve the evaluation methods of research teams, focusing on cooperation in solving major scientific and technological problems and fully recognizing and fairly treating the actual contributions of all team participants.

In conclusion, with continuous support from the government, university S's reforms bring together resources, capital, and enterprises to promote interdisciplinary cooperation, pursue major innovation advancement, and develop a sustainable innovation system highlighting interdisciplinary research. Although these interdisciplinary education reforms and practices seem to be effective, empirical evidence is still rare. Therefore, the following research questions are proposed under the context of accelerated research universities to empirically test whether IDR accelerates research performance at faculty level and its possible mechanisms: does interdisciplinary research lead to higher faculty performance in terms of research productivity, impact, and prestige in accelerated research universities in China? Are there heterogeneous effects of interdisciplinary research among faculty members in such universities? Is there any peer effect of interdisciplinary research? Answering these questions would be the starting point to understand and leverage research accelerated universities' advantages in its research modes across disciplines when increasingly more interdisciplinary research platforms and projects have been launched in China's universities.

3. Literature Review

It is emphasized by the previous study that interdisciplinary connections are fundamental to all future research because the interfaces of the sciences are the most intense [10]. Interdisciplinary research can be roughly divided into two forms: collaboration research and individual interdisciplinary. Collaboration among scientists can be considered a typical form of scientist-scientist interaction [11]. Despite the interdisciplinary by collaborating with authors from different institutions or disciplines, a single author can also make an interdisciplinary study. Some papers categorized as "non-collaborative" were written by highly interdisciplinary individuals, who were not reflected in authorship [12].

Interdisciplinary research can improve researcher performance in many ways. Many observations find that interdisciplinary can increase productivity. At the university level, universities support their interdisciplinary by raising interdisciplinary departments and research centers, this can be seen as the structural commitment to IDR [13]. Such commitment to IDR can improve the interdisciplinary scholarly productivity of institutions [14]. At the individual level, whether interdisciplinary research has greater productivity has been controversial. Karr's [15] study indicates that scientific productivity increases exponentially with a scientist's interdisciplinarity and that of their collaborators. However, in Leahey's [16] statistics, interdisciplinary scientists experience lower productivity. She finds that in the year when scholars do more interdisciplinary work, they publish fewer articles. However, interdisciplinary productivity is influenced by many other factors, such as gender, age, the position of authors, the quality of colleagues' publications, and so on [17–19].

In the academic field, citations can be used as a factor to measure academic impact, because citations can reflect the visibility of the paper in the scientific community [20–22]. At the university level, the scientific publications published by collaborations have positive externalities for all the universities [23]. For scholars, Leahey's [16] study shows that interdisciplinary can increase scholarly visibility, in other words, IDR can increase scholars' impact. Along with the trends over time, higher interdisciplinary publications tend to attract more citations and have higher PLoS usage [24]. Shi et al. [25] used the bibliometric to quantify the effect of interdisciplinary research. They found that authors who cite across

disciplines can garner more citations, which are measured as impact. This result indicated that the cross-fertilization of research has a significant impact on research performance. They also found that in the natural science area, those who draw research outside of their area will have more influence on their study. While in social science, the impact of their research is affected by one's field. Despite two extremes existing, highly collaborative but slightly interdisciplinary and highly interdisciplinary individuals, collaboration positively correlated with interdisciplinarity [11]. In the study of some European countries, the knowledge flows among researchers from different universities are relevant to enhancing the quality of research. The collaborations can improve the effectiveness of research and raise the performance level [26].

In addition, interdisciplinary research can also play a role in higher-level research. Interdisciplinarity will be more relevant and responsive to public needs and concerns [27]. IDR is also good at problem solving. Stirling [28] argues that IDR is more successful at problem solving. Since cognitive diversity can help in hedging against ignorance and accommodating plural perspectives, IDR can be seen as a source of creativity and innovativeness because it challenges established approaches and discovers new areas of research.

Though IDR brings benefits to research performance, it also entails metaphorically costs, such as coordination costs and institutional barriers which are also explained as a disadvantage with an appreciation of the value of interdisciplinary research [29]. In Yegros-Yegros's [30] study, there is an inverted U-shape relationship between IDR and citation impact. The curvilinear relationship indicates that three is an initial positive effect on the citation impact of publications, but higher levels of diversity will have a detrimental effect on the citation impact of publications. One characteristic is that highly disciplinary and highly interdisciplinary articles have a low scientific impact. There might be an optimum of interdisciplinarity [31]. Wang et al. [32] show that the number of citations with a low interdisciplinary degree was greater than that of papers with a high interdisciplinary degree. In other words, there is an "optimal value" between influence and degree of interdisciplinarity. When the interdisciplinary degree reaches a certain value (not the maximum value), the influence of the paper is the greatest.

4. Research Design

4.1. Research Hypothesis

As discussed in the previous section, we argue that although interdisciplinary research is often valued more than single discipline research in theory, there is no simple relationship between interdisciplinary research and research performance at the individual level, and it may be the role of benefit or penalty [16]. Therefore, we examine whether conducting interdisciplinary research affects the number of publications, research impact, and prestige of faculty individuals having by proposing the following hypothesis:

Hypothesis 1a: *Compared with non-interdisciplinary research, interdisciplinary research is associated with higher faculty performance in terms of productivity, impact, and prestige.*

Hypothesis 1b: *The degree of interdisciplinary research/interdisciplinarity is associated with higher faculty performance in terms of productivity, impact, and prestige.*

Faculty's intrinsic individual characteristics may decide whether they involve in IDR and how they behave. Who reaps more benefits from conducting IDR? Bird [33] has done an interdisciplinary interview study on women in academics. In addition to gender, working experiences and research orientation also seem to play roles. Evans [34] emphasizes encouraging young academics into the interdisciplinary field and making them into interdisciplinarians. However, in contrast, young scientists who are exposed to more interdisciplinary topics run the risk of taking longer to establish themselves in their careers [10]. In fact, interdisciplinary work often has an applied orientation [35]. Hence, we postulate:

Hypothesis 2a: *The impact of interdisciplinary research is heterogeneous among faculty members with different working experiences, and young faculty are more likely to be influenced.*

Hypothesis 2b: *The impact of interdisciplinary research is heterogeneous among faculty members with different research orientations, and faculty who engaged in applied-oriented research are more likely to be influenced.*

In fact, interdisciplinary research behavior is an interaction in nature and depends highly on university schools, departments, or centers, which constitute organizational pools of scientific and technological human capital based on the skills, knowledge, abilities, and resources of their participants. Carayol [18] argued that the university and laboratory are the loci of interactions, therefore, it is important to combine individual and collective determinants to explain individual research productivity. Colo [36] and Hansen et al. [37] demonstrated that individuals who work in universities with high prestige, high reputation, and are high quality are more productive and more often cited. Productivity is also affected by the size of institutions. The size of institutions negatively correlated with productivity [17]. That is, permanent researchers publish more when they are in smaller institutions, which can be explained that smaller institutions will have lower coordination costs, quicker decision-making, lower administrative burden, etc. [18]. Boardman and Corley [38] demonstrated that university centers can be seen as a tool for making interdisciplinary and cross-sector synergies, thus improving research and development. Research centers facilitate their interactions and collaboration by providing their affiliated and external faculty, industry partners, and other stakeholders with resources and interaction opportunities. Thus, for individuals, affiliating researchers can enhance their research capacities by accessing these resources [39]. In addition, in Ponomariov and Boardman's study [40], the probability of researchers who are affiliated with boundary-spanning centers co-authoring with researchers in other fields is higher. In our study, we examined how faculty would behave under the context of this accelerated research University S when surrounded by peers highly engaging in IDR. Therefore, the following hypotheses were proposed concerning the potential peer effects at the school level:

Hypothesis 3a: *There exist positive peer effects between the mean degree of interdisciplinarity at the school level and faculty individual IDR.*

Hypothesis 3b: *There exist positive peer effects between the standard deviation of degree of interdisciplinarity at the school level and faculty individual IDR.*

4.2. Data

As shown in Figure 1, in this study, we constructed a dataset from several sources and follow the procedure below: first, we collected personal profiles for all faculty working at University S. The university faculty profile information is collected through web scrapes for a total of 919 faculty members by the end of December 2020. Second, we use the faculty's unique identifier, including their researcher ID and Scopus researcher ID to obtain their research performance indicators in the last three years (2018–2020) and interdisciplinary information. The bibliometric information of these faculty, such as the number of publications, and the number of citations, came from Elviser's SciVal platform. We obtained data on interdisciplinarity, notably their SciVal subject categories (SCs), which we used to measure the degree to which each faculty's research is interdisciplinary. Third, the two previous datasets were merged to generate a whole dataset with both faculty individual characteristics and research performance. This yielded a cross-sectional dataset that contains both the faculty Curriculum Vitae and bibliometric records [41–44]. We will discuss the definition and present the descriptive statistics of outcome variables in the next section.

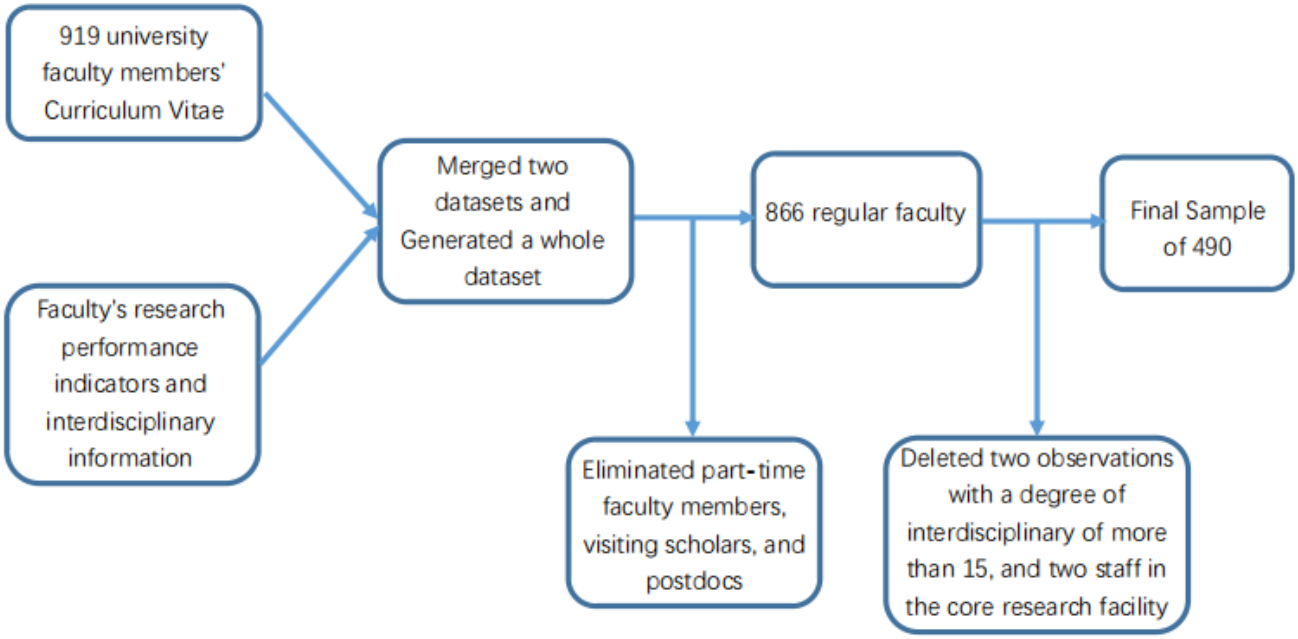

Figure 1. Data Construction Procedure.

There are several rules for sample selection. First, our analysis is limited to the subset of 866 regular faculty. Part-time faculty members, visiting scholars, and postdocs are eliminated from the sample. Next, two observations with a degree of interdisciplinary of more than 15 are deleted because they are likely to be outliers. Similarly, two staff in the core research facility are deleted from the sample. Then, the sample is further reduced to keep only those with a publication record as of 2018–2020 in Scopus because research performance indicators and degree of interdisciplinary research cannot be computed for faculty who have not published during this period. This leaves us with a sample of 499. The final sample for regression analyses is 490.

4.3. Methods

To answer research question 1, we use multivariate regression analyses to assess the effect of interdisciplinary research on faculty research performance outcomes while accounting for relevant control variables. First, the ordinary least squares (OLS) regression analyses were performed to predict research productivity, impact, and prestige. The baseline model includes the indicator for interdisciplinary research and controls for faculty individual characteristics, school fixed effects, and faculty entry year fixed effects is specified as follows:

$$Y_{it} = \alpha + \beta_1 Interdisciplinary_{it} + \gamma X_{it} + \eta_{school} + \mu_{year} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the measures of research performance for faculty i in t time period of 2018–2020; $Interdisciplinary_{\mathrm{it}}$ indicates the faculty i's interdisciplinary research status or degree of interdisciplinarity in 2018–2020; X_{it} includes faculty i's individual characteristic control variables; η_{school} is the school fixed-effects; μ_{year} is the faculty entry year fixed-effects; and ε_{it} is the error term. We cluster standard errors at the school level, accounting for correlation in research performance for faculty in the same school.

Then, the coarsened exact matching (CEM) method is employed to improve the estimation of causal effects of conducting interdisciplinary research given the observational data. CEM is a matching algorithm that eliminates the need for a separate procedure to restrict data to common empirical support and is robust to measurement errors. According to Iacus, King, and Porro [45], CEM provides matching solutions that are better balanced and estimate of the causal quantity of interest that have lower root mean square error than

methods such as based on propensity scores, Mahalanobis distance, nearest neighbors, and optimal matching.

Moreover, since there might exist heterogeneous effects when considering the effect of interdisciplinary research among faculty groups, we assess whether there are heterogeneous effects by including possible interaction terms in model (1).

To test hypothesis 3 about the potential peer effect of interdisciplinary research, we further calculated the mean and standard deviation of the degree of interdisciplinarity at the school level to capture the concentration and variability in faculty interdisciplinarity at the school level.

4.4. Variables

4.4.1. Dependent Variables

Research Productivity. To capture each faculty's quantity dimension of research performance, we relied on the total number of articles published in Scopus journals in the last three years from 2018 to 2020 to measure research productivity. This is a measure of productivity that includes all types of publications such as journal articles, book chapters, and others. It is more accurate than survey data which is usually collected from self-reported publication figures.

Research Impact. We measured an individual's research impact by collecting the Field-Weighted Citation Impact (FWCI) index, citation counts, and the number of citations per publication that had accrued in the Scival Dataset form 2018 through 2020. FWCI in SciVal indicates how the number of citations received by an entity's publications compares with the average number of citations received by all other similar publications in the dataset [46,47]. Citations per publication at the individual level is a more precise personal measure of research impact than publication-level or journal-level measures.

Research Prestige. We measured research prestige by two indicators: outputs in top citation percentiles (OTCP) and publications in top journal percentiles (PTJP) in Scival. OTCP indicates the extent to which a faculty's publications are present in the top 10% of the most-cited publications. It signals the scholar's contribution towards the most influential, highly cited publications in similar disciplines. PTJP indicates the extent to which a faculty's publications are present in the top 10% of the most cited journal indexed by Scopus. The most cited journals are defined by the journal metrics which show the presence of publications in journals that are likely to be perceived as the most prestigious in the world.

4.4.2. Key Independent Variable: Interdisciplinary Research

The key independent variable of interest in this study is measured in two ways. The first way is to generate a dichotomous indicator to show whether the faculty has conducted interdisciplinary research or not. Faculty who have publications in more than one subject category are considered as conducting interdisciplinary research. This variable is a dichotomous indicator (1 = if interdisciplinary, 0 = not interdisciplinary).

The second way is to measure the degree of interdisciplinarity continuously. The continuous variable ranges in value from 1 to 15 with the value 1 indicating single discipline research and the value larger than 1 indicating the faculty has publications in multiple subject categories. It accounts for the diversity of a researcher's publication over scientific domains.

4.4.3. Control Variables

It is necessary to account for other variables that affect the relationship between interdisciplinary research and faculty performance outcomes. Thus, a number of control variables are employed in the multivariate regression models. The first sets of control variables are faculty individual characteristics that may be associated with their research performance. These variables include faculty demographic variables gender, age groups, returnee status, postdoc experience, tenure-track status, and academic ranks. We also

control for four major modes of research collaboration, namely, institutional collaboration, national collaboration, international collaboration, and academic-corporate collaboration to eliminate the effects of other kinds of collaboration.

The variation in interdisciplinary research and academic performance may be due to the difference in fields of study. Therefore, school fixed effect variables are controlled to account for the invariant school characteristics over time. University S has degree programs across six schools including the College of Science (CoS, the reference group), the College of Engineering (CoE), the School of Medicine (SoM), the College of Business (CoB), the School of Innovation and Entrepreneurship (SIE), the School of Humanities and Social Sciences (SHSS), and others.

The sample contains faculty who entered the university across a span of 2011–2021. Therefore, we included entry school year fixed effects variables, which are a series of entry year dummy variables representing the year when the faculty entered this university in the models to account for the fact that some outcomes may be impacted by when they entered the university settings. Faculty who entered University S in 2021 is the omitted reference group.

5. Results

5.1. Descriptive Results

Figure 2 depicts the histogram of the degree of interdisciplinarity for the whole sample. According to Figure 1, only 5.41 percent of the faculty conducting research in a single discipline, with the other 94.59 percent coming from two and more disciplines. Among those who are interdisciplinary, there are divergent differences in the extent or degree of interdisciplinarity held by faculty members. For example, 11.62 percent of the interdisciplinary faculty represented in our sample have publications in two disciplines compared with only 0.2 percent of the faculty who have publications in fifteen disciplines. Most of the faculty have publications concentrating on 2 to 11 subject categories.

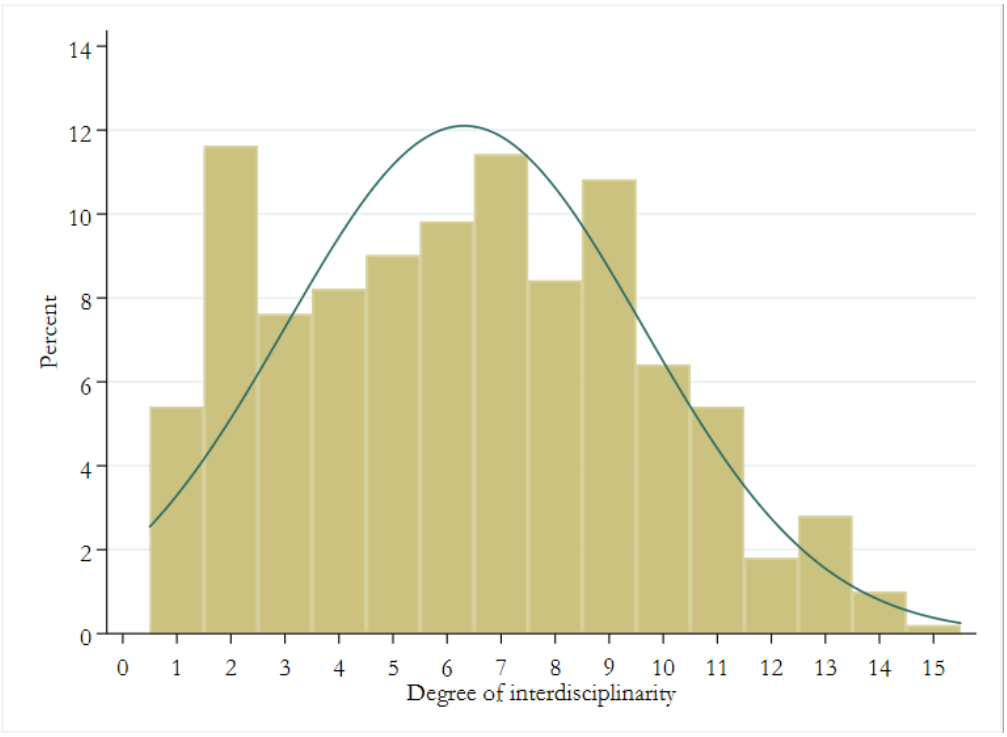

Figure 2. The distribution of the degree of interdisciplinarity.

Figure 3 shows the sample distribution of the average degree of interdisciplinary research by the college in the sampled university. Our data corroborate this: the degree of

interdisciplinarity is higher for faculty in applied science disciplines such as the College of Engineering, School of Innovation and Entrepreneurship, the Academy for Advanced Interdisciplinary Studies, and the School of Medicine, but slightly less for those in schools that concentrate on basic sciences such as science, and humanities and social sciences.

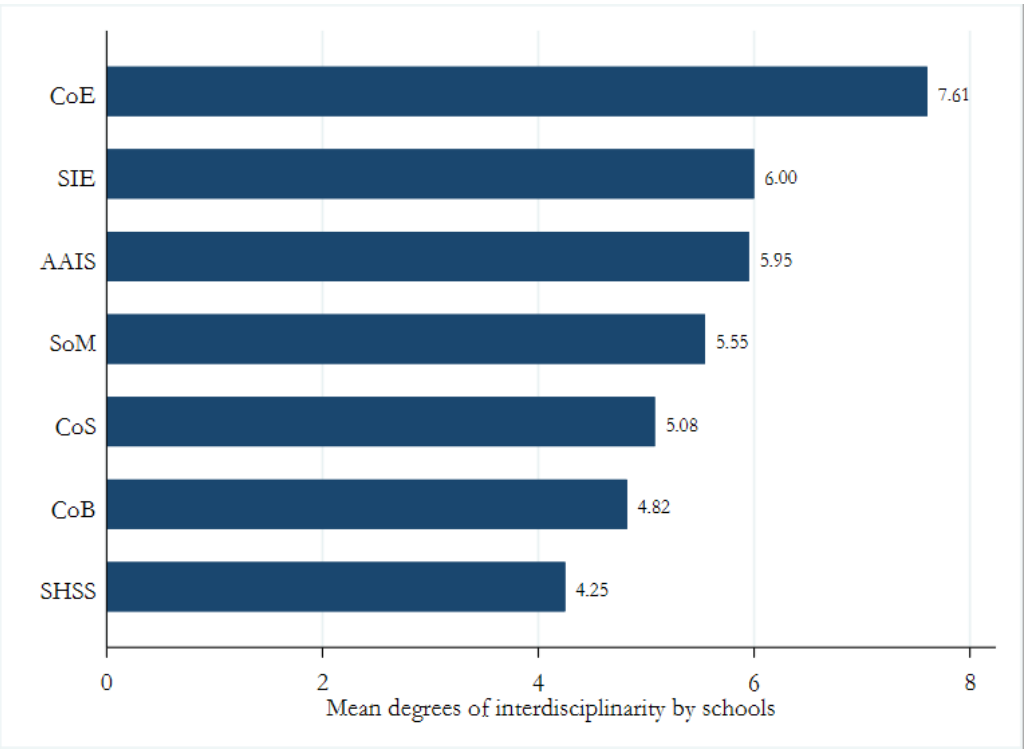

Figure 3. The mean of degree of interdisciplinarity by school. Notes: 1. CoE denotes College of Engineering; SIE denotes School of Innovation and Entrepreneurship; AAIS denotes Academy for Advanced Interdisciplinary Studies; SoM denotes School of Medicine; CoS denotes College of Science; CoB denotes College of Business; and SHSS denotes School of Humanities and Social Sciences. 2. 5.95% of faculty are affiliated with AAIS only; however, some faculty may have dual affiliations in AAIS and in other schools.

Table 1 displays the descriptive statistics for all the dependent and individual level independent variables for the full sample and by interdisciplinary research status. Not all of the key variables of interest (the dependent variables) show statistically significant differences between interdisciplinary and non-interdisciplinary respondents. T-tests reveal that there are significant differences between means for research productivity, impact, and prestige as measured by scholarly output, citation counts, and PTJP. The interdisciplinary faculty members have a higher average number of publications than non-interdisciplinary researchers. The t-test results in Table 1 also indicate that interdisciplinary faculty have significantly higher citation counts and PTJP than their non-interdisciplinary counterparts.

Table 1. Descriptive statistics for full sample and by interdisciplinary research status.

Variables	Full Sample (n = 499)	Non-Interdisciplinary (n = 26)	Interdisciplinary (n = 473)	Mean Differences
Dependent Variables				
Scholarly outputs (2018 to 2020)	20.29	3.23	21.23	−18.00 ***
Field-Weighted Citation Impact (2018 to 2020)	1.86	1.24	1.89	−0.65
Citation counts (2018 to 2020)	265.72	23.12	279.11	−256.00 ***
Citations per publication (2018 to 2020)	12.36	8.05	12.60	-4.55
Outputs in Top Citation Percentiles (OTCP, 2018 to 2020)	0.21	0.18	0.21	−0.03
Publications in Top Journal Percentiles (PTJP, 2018 to 2020)	0.53	0.25	0.55	−0.30 ***
Independent Variables				
Only institutional collaboration (2018 to 2020)	0.15	0.20	0.14	0.06
Only national collaboration (2018 to 2020)	0.30	0.24	0.30	−0.06
International collaboration (2018 to 2020)	0.53	0.45	0.54	−0.09
Academic-corporate collaboration (2018 to 2020)	0.03	0.02	0.04	−0.01
Gender (=1, Male; =0, female)	0.88	0.89	0.88	0.01
Young faculty (=1, yes; =0, otherwise)	0.55	0.63	0.54	0.09
Middle faculty (=1, yes; =0, otherwise)	0.40	0.37	0.40	−0.03
Senior faculty (=1, yes; =0, otherwise)	0.05	0.00	0.06	−0.06
Returnee (=1, yes; =0, otherwise)	0.67	0.78	0.66	0.12
Postdoc experience (=1, yes; =0, otherwise)	0.74	0.67	0.74	−0.08
Tenure-track status (=1, yes; =0, otherwise)	0.80	0.78	0.80	−0.03
Assistant professor (=1, yes; =0, otherwise)	0.27	0.48	0.26	0.22 **
Associate professor (=1, yes; =0, otherwise)	0.39	0.37	0.39	−0.02
Full professor (=1, yes; =0, otherwise)	0.33	0.15	0.34	−0.20 **

Notes: Young faculty are those born in the 1980s and younger; Middle faculty are those born between the 1960s and 1970s; Senior faculty are those born in the 1950s and before. T-tests for differences in means between interdisciplinary and non-interdisciplinary faculty were conducted. Significance: ** $p < 0.05$, *** $p < 0.01$.

The differences in means and proportions are not significant in faculty demographics and research collaborations, but they are obvious for faculty academic rank composition. For example, the distribution of faculty across academic ranks differs for interdisciplinary and non-interdisciplinary faculty. The proportion of non-interdisciplinary faculty is much higher holding assistant professor positions. However, interdisciplinary faculty are more likely to hold full professor ranks.

5.2. The Impact of Interdisciplinary Research on Faculty Performance

Table 2 reports the results obtained from multivariate regression analyses for two panels to examine the interdisciplinary research on faculty research productivity, impact, and prestige, respectively. By both binary measure and continuous measure, the models presented in Table 2 demonstrate that interdisciplinary research has a positive effect on faculty's research performance. Those who conducted interdisciplinary research have significantly more publications than those who did not. Furthermore, faculty engaged in interdisciplinary research have publications with higher research impact and prestige. The results show that in the short-run, interdisciplinary faculty may have advantages over their non-interdisciplinary counterparts in carrying out higher quality and more prestigious research. Meanwhile, we tried to examine how the degree of interdisciplinarity influence research performance and found that the degree of interdisciplinarity promotes faculty's research performance in terms of productivity, impact, and prestige. In other words, when the faculty conducted research in more discipline categories, they tended to perform better.

Table 2. Baseline results.

	# Outputs	FWCI	# Citations	Citations per Publication	OTCP	PTJP
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. binary measure: interdisciplinary vs. non-interdisciplinary						
Interdisciplinary (=1, interdisciplinary)	9.69 ***	0.49	105.62 **	2.74	0.00	0.23 ***
	(2.30)	(0.55)	(32.50)	(3.45)	(0.09)	(0.06)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	490	490	490	490	490	490
R-squared	0.33	0.12	0.22	0.15	0.11	0.19
Panel B. continuous measure: the degree of interdisciplinary research						
Interdisciplinary (normalized)	10.27 ***	0.14	169.75 ***	1.92 **	0.04 ***	0.07 **
	(1.30)	(0.15)	(18.99)	(0.71)	(0.01)	(0.02)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	490	490	490	490	490	490
R-squared	0.50	0.12	0.36	0.16	0.14	0.20

Notes: Standard errors are clustered at the school level and reported in parentheses. Significance ** $p < 0.05$, *** $p < 0.01$.

Second, we employed the CEM approach to re-estimate the relationship between interdisciplinary research status and faculty's performance to ensure the validity of the estimation, as shown in Table 3. CEM-based causal estimates possess a large variety of other powerful statistical properties, and CEM generated matched data sets with lower imbalance and a larger sample size [47], As a robustness check, the results listed in Table 3 show that the interdisciplinary research status is still significantly associated with research productivity and prestige; however, it is only significantly associated with research impact at the 10% significance level. The CEM approach results are generally consistent with multivariate regression results, which lend further support to our argument from the OLS results. It is also worth noting that the magnitude of coefficients in CEM is larger than that of multivariate regression analyses. It might because that CEM captures the average treatment on the treated (ATT) effect and is based on a reduced sample with more comparable faculty.

Table 3. Robustness check using the coarsened exact matching (CEM) approach.

	Outputs	FWCI	# Citations	Citations per Publication	OTCP	PTJP
	(1)	(2)	(3)	(4)	(5)	(6)
Interdisciplinary (=1, interdisciplinary)	12.75 **	0.91	170.18 *	4.98	0.05	0.25 *
	(4.84)	(0.67)	(74.22)	(4.62)	(0.10)	(0.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	302	302	302	302	302	302
R-squared	0.37	0.16	0.25	0.20	0.14	0.23

Notes: Standard errors are clustered at the school level and reported in parentheses. Significance: * $p < 0.1$, ** $p < 0.05$.

Then, considering that the impact of interdisciplinary research status on faculty performance may differ by faculty groups and fields of study, this article further examines the potential heterogeneity by introducing interaction terms between interdisciplinary research status dummy and young faculty group dummy and applied science faculty group dummy in the regression models. As shown in Table 4, the results tell us who reaps more benefits

and who suffers from engagement in interdisciplinary research. The results reveal that the benefits of faculty engagement in interdisciplinary research may not be equally distributed among different faculty age groups. Compared with senior faculty, young faculty may suffer from engagement in interdisciplinary research, especially their research prestige may be negatively affected. This finding is consistent with the previous belief that interdisciplinary research delays career progression, or it is the luxury of senior researchers since it takes a longer time to publish joint interdisciplinary research in high-impact journals. Through another perspective, different research orientations can also yield various results. Faculty in applied-oriented research benefit more from engaging in interdisciplinary research by generating higher quantity and more prestigious publications than faculty in basic sciences.

Table 4. Heterogeneous effect of interdisciplinary research on faculty performance by OLS with interaction terms.

	Outputs	**FWCI**	**# Citations**	**Citations per Publication**	**OTCP**	**PTJP**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Panel A. heterogeneity by faculty's working experience						
Interdisciplinary × Young faculty	−7.13 *	0.45	−64.34	6.40 ***	−0.07	−0.20 ***
	(3.06)	(0.30)	(53.37)	(1.67)	(0.08)	(0.03)
Interdisciplinary (=1, yes)	13.96 **	0.22	144.10 *	−1.09	0.04	0.35 ***
	(4.32)	(0.43)	(61.01)	(3.64)	(0.06)	(0.07)
Young faculty (=1, yes)	9.30	0.34	171.66	−2.32	0.15 **	0.31 ***
	(9.76)	(0.44)	(192.62)	(3.07)	(0.05)	(0.07)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	490	490	490	490	490	490
R-squared	0.34	0.12	0.22	0.15	0.11	0.19
Panel B. heterogeneity by research orientations						
Interdisciplinary × Applied-oriented research	7.59	1.87	140.68 *	11.61 *	0.32 ***	0.22 **
	(3.97)	(1.00)	(69.42)	(5.71)	(0.04)	(0.07)
Interdisciplinary (=1, yes)	7.44 ***	−0.07	63.60 *	−0.71	−0.10 ***	0.17 ***
	(0.44)	(0.10)	(29.24)	(0.97)	(0.01)	(0.02)
Applied-oriented research (=1, yes)	−13.84 **	−1.90 **	−245.35 **	−15.16 **	−0.44 ***	−0.63 ***
	(4.77)	(0.58)	(98.71)	(5.15)	(0.07)	(0.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	490	490	490	490	490	490
R-squared	0.34	0.13	0.22	0.15	0.13	0.19

Notes: Young faculty are those born in the 1980s and younger. Faculty in Applied-oriented research means faculty belongs to CoE, SoM, SoB, SIE, AAIS schools, otherwise belongs to basic research. Standard errors are clustered at the school level and reported in parentheses. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3. The Peer Effect of Interdisciplinary Research

To test Hypothesis 3, we estimated the relationship between school level mean and standard deviation of the degree of interdisciplinarity and faculty's degree of interdisciplinarity. The results listed in Table 5 suggest that there exist peer effects on faculty's interdisciplinary research behavior, which means the faculty's individual level degree of interdisciplinarity is positively associated with the average degree of interdisciplinarity at the school level, but it is negatively associated with the school level standard deviation of the degree of interdisciplinarity. It echoes the finding that distal disciplinary research might be too risky and more likely to fail, thus disparity of the degree of interdisciplinary research may have a negative effect [30]. The results hold for faculty in both basic and applied-oriented research. The results suggest that the school climate and environment of pursuing and encouraging interdisciplinary research may enhance faculty individual engagement in interdisciplinary research practices and involvement in research with more subject categories. With school peers pursuing publications in a range of subject categories, other faculty will emulate to publish articles across more subject boundaries. However, when the diversity of interdisciplinary subject categories increases, it is less supportive for conducting research in a wide range of subject areas.

Table 5. Regression results of the peer effect of interdisciplinary research.

	(1)	(2)	(3)
	All	**Basic Research**	**Applied-Oriented Research**
Mean of degree of interdisciplinarity	2.21 ***	2.13 ***	1.08 ***
	(0.07)	(0.08)	(0.02)
Standard deviations of degree of interdisciplinarity	−0.84 ***	−0.70 **	−0.57 *
	(0.08)	(0.07)	(0.14)
Controls	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes
Entry year fixed effects	Yes	Yes	Yes
Observations	491	221	270
R-squared	0.29	0.20	0.24

Notes: Faculty in Applied-oriented research means faculty belongs to CoE, SoM, SoB, SIE, AAIS schools, otherwise belongs to basic research. Standard errors are clustered at the school level and reported in parentheses. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6. Discussion

First, the results confirmed that interdisciplinary research has significant impacts on faculty research productivity, impact, and prestige. In other words, faculty engaging in interdisciplinary research tend to have more publications and publish more papers with higher impact and in top-tier journals. These results align with the previous studies conducted by Karr [15], which found that research productivity and scientist's interdisciplinarity were positively correlated and it portraits a path to scientific success through a road of collaboration and interdisciplinary exchange, rather than intense focus and specialization. Previous studies examined the academic impact measured by citations revealed that IDR has significant impact on research impact [24,48]. Although previous studies emphasized that IDR are not necessarily of lower quality, they may encounter cognitive and collaborative challenges and more hurdles during peer review and lower productivity [16]. Results from this study suggest IDR promoted by accelerated research universities spurs transformative science and innovation in the short-run and it is beneficial in promoting research performance dimensions including productivity, impact, and prestige. In terms of degree of interdisciplinarity, Yegros-Yegros, Rafols, and Deste [30] stated that the variety of disciplines has a positive effect on impact, whereas balance and disparity have a negative effect. Our findings are consistent with the view that combining multiple fields has a positive effect on knowledge creation. Another study assessed the interdisciplinarity patterns of highly cited papers and found that highly cited papers always exhibit higher variety and disparity [49]. The current study aligns with this literature, confirming the IDR is the most important factor for gaining research prestige.

In addition, similar results were generated from this study that the impacts of conducting interdisciplinary research vary across faculty subgroups. In our study, we found that compared with seniors, young faculty may suffer from conducting interdisciplinary research, while faculty in applied-oriented research or disciplines reap more benefits than those in basic science. Our finding is consistent with the view that high interdisciplinarity is an advantageous strategy for senior scientists, whereas intense focus is optimal for young scientists [15]. This makes sense because existing research usually highlights the tension between innovation gains brought by spanning disciplines and penalty of increasing subject categories, thus the costs and benefits of pursuing IDR depend on characteristics of the field and scientist's place in it [16]. From the career development perspective, a young scientist needs to focus on his or her research fields or interests at the early career stage and shift to broader IDR collaboration as a scientist establishes him/herself. Career goals and planning should also differ for scientists in different scientific career stages and for scientists in various disciplines.

Lastly, we address the peer effects of faculties' IDR behavior, which enriches the literature on faculty research collaboration and interaction in the context of research universities. The average school level degree of interdisciplinarity increases research subject categories at the faculty individual level, while the dispersion of school level interdisciplinarity decreases research subject categories at the faculty individual level. Additionally, the school climate and environment of pursuing and encouraging interdisciplinary research may enhance faculty individual engagement in interdisciplinary research practices and involvement in research with more subject categories. This coincides with Hansen's [37] ideas. Ponomariov and Boardman [40] emphasized the importance of cooperation, while raising the visibility of the early work of scientists who have achieved greater reputation and focusing attention on the work of a lesser known somebody who works with well-known scientists [36]. Our study also recognizes the positive role of collaboration in interdisciplinary.

7. Conclusions

The interdisciplinary research approach was claimed to be desirable for solving global challenges and complex societal problems in which integrating of the insights of different disciplines to provide a more comprehensive solution than can be offered by any given discipline [50], thus interdisciplinary research is essential for sustainability. On the other hand, universities are relevant to sustainable strategies and SDGs [7], through an interdisciplinary research approach to foster innovation and address major scientific challenges [14], which in turn can contribute to a sustainable future.

This study is motivated by these claims to empirically explore the status and degree of interdisciplinary research on faculty's research performance. The conventional school/department system is a major obstacle to interdisciplinarity. Faculty culture can foster a strong professional identity, which may lead to prejudice against other fields. Therefore, how to break the shackles of the original colleges and departments and let scientists from different colleges and departments sit around the same round table and burst out sparks of thinking is an urgent problem to be solved. New Chinese accelerated research universities are taking the lead in this direction. At the same time, many scholars have discussed interdisciplinary research in universities from the organizational level [51–53]. In contrast, our research perspective targets individual faculty members, and, by analyzing their data, we answer the question of whether interdisciplinary research contributes to faculty research performance and thus helps to further develop interdisciplinary research in Chinese universities. Thus, this study contributes to the literature by empirically evaluating the effect of pursuing interdisciplinary research through institutional reforms under the context of building accelerated research universities in China. An understanding of these can provide starting points for the design of policy instruments that stimulate and foster IDR in this transformative development of building world-class universities and innovative higher education systems nationwide.

For university administrators and policymakers who aim to stimulate interdisciplinary research and innovation, the study's findings have significant implications and can provide some ideas for use as a guide.

First, interdisciplinary research has become the main knowledge production mode and faculty conducting interdisciplinary research are prevalent in accelerated research universities. This fact suggests that the recruitment of faculty with an educational background in multiple disciplines or having prior interdisciplinary co-supervision or research working experience might help to increase interdisciplinary activities at the university level. Accelerated research universities manage to maintain a very high proportion of faculty (over 90%) engaging in such research mode. Moreover, since faculty in different schools engage in interdisciplinary research proportionately, it suggests that university administrators should not only embrace policies that pursue multidisciplinary research excessively but also need to consider the traits of discipline and weigh the costs and benefits of involving in IDR.

Second, since the effects of interdisciplinary research are heterogeneous, we advise designing policy instruments to distinguish between young and senior faculty, and faculty in basic and applied sciences or disciplines. Given that young faculty members face the trade-off of publishing interdisciplinary research and obtaining research prestige, universities can offer more help to remove obstacles that hinder a young faculty's willingness to conduct interdisciplinary research. Research institutions that want to vigorously enhance interdisciplinary cooperation should have better evaluation policies designed to coordinate and achieve the balance between research quantity and quality. Faculty in applied-oriented science and disciplines are more likely to conduct interdisciplinary research to gain higher prestige because applied sciences can be a platform where a variety of cutting-edge applied disciplines intersect to obtain high-level innovation results, and many scientists from different disciplines may harness the applied science resources to advance their research.

Third, it seems that interdisciplinary research means choosing a different path with more challenges and risks, and thus requires a supportive environment and efforts. Since one's research subject category decision could be affected by colleagues with a considerable amount of degree of interdisciplinarity, improving the working environment and assigning more co-workers with large research spans in the same school might stimulate a similar pattern of conducting interdisciplinary research. There might be two channels for peer effects in the workplace. One probable channel is that strong peers bring higher pressure, forcing other faculty to conduct interdisciplinary research. Another possibility is that within school spillovers of knowledge and skills through communication and collaboration will promote IDR. Meanwhile, it should be noted that involving in IDR with divergent subject categories might be demanding and it is not necessarily the optimal choice.

Lastly, achieving the SDGs requires interdisciplinary research collaboration and new practices in accelerated research universities in China offer instructive and valuable experiences. The linkages and dynamics of the SDGs are complex, and these dynamics naturally coincide with the technological and application issues that call for multidisciplinary solutions [54]. Addressing the SDGs from an interdisciplinary perspective because an interdisciplinary approach can create a learning setting that stimulates problem solving competencies for sustainability-related issues [55]. Meanwhile, there are still various factors that have resulted in Chinese scholars' low international visibility at present; however, cross-border research collaboration can help relieve these challenges faced by Chinese scholars [56]. As co-innovation arises through collaboration, higher education has been viewed as an "engine" for innovation as well as a "catalyst" for sustainable development [57]; all forms of interdisciplinary research partnerships and co-innovation should be encouraged. Not only the interdisciplinary cooperation at the faculty level but also the building of university-industry co-innovation networks and platforms that offer insights into the norms and cultures of other disciplines. Experiences from accelerated universities elsewhere have already shown that visionary leadership and generous funding combined with innovative ideas such as niche institutions or programs with an interdisciplinary approach can yield impressive results in a short time [58]. The lessons from this sampled university further prove that accelerated research universities in China highlighting IDR achieve significant research performance and academic excellence at the early stage, which becomes an important path for obtaining sustainable and innovation-driven development.

It is important to note several limitations. Although the data used in this study are the best available and retrieved from multiple data sources, it is cross-sectional data and we still need to carefully examine the causality between interdisciplinary research and faculty performance with longitudinal follow-up surveys or administrative data in the future. Despite the ability of this study to directly address the role played by conducting interdisciplinary research in a sampled university, future efforts should attempt to make larger-scale assessments in other higher education institutions currently labeled as accelerated research universities to see how and why this interdisciplinary research movement impacts the research process.

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References

1. Villeneuve, D.; Durán-Rodas, D.; Ferri, A.; Kuttler, T.; Magelund, J.; Mögele, M.; Silva, C. What is interdisciplinarity in practice? Critical reflections on doing mobility research in an intended interdisciplinary doctoral research group. *Sustainability* **2019**, *12*, 197. [CrossRef]
2. Ramaswami, A.; Weible, C.; Main, D.; Heikkila, T.; Siddiki, S.; Duvall, A.; Pattison, A.; Bernard, M. A Social-Ecological-Infrastructural systems framework for interdisciplinary study of sustainable city systems an integrative curriculum across seven major disciplines. *J. Ind. Ecol.* **2012**, *16*, 801–813. [CrossRef]
3. Bruno, M.C.; Siviglia, A. Assessing impacts of dam operations—Interdisciplinary approaches for sustainable regulated river management. *River Res. Appl.* **2012**, *28*, 675–677. [CrossRef]
4. Kim, S. Interdisciplinary approaches and methods for sustainable transformation and innovation. *Sutainability* **2015**, *7*, 3977–3983. [CrossRef]
5. Cheng, X.; Pan, W.; Zhang, Q. Antecedents of knowledge interaction in the sustainable interdisciplinary research team: A mixed research method. *Sustainability* **2019**, *11*, 3624. [CrossRef]
6. Griffiths, T.G. Education to transform the world: Limits and possibilities in and against the SDGs and ESD. *Int. Stud. Sociol. Educ.* **2021**, *30*, 73–92. [CrossRef]
7. Alam, G.M.; Roslan, S.; Al-Amin, A.Q.; Leal Filho, W. Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'—Policy Framework to Respond COP21. *Sustainability* **2021**, *13*, 4520. [CrossRef]
8. Shechtman, D.; Blech, I.; Gratias, D.; Cahn, J.W. Metallic phase with long-range orientational order and no translational symmetry. *Phys. Rev. Lett.* **1984**, *53*, 1951. [CrossRef]
9. Szell, M.; Ma, Y.; Sinatra, R. A Nobel opportunity for interdisciplinarity. *Nat. Phys.* **2018**, *14*, 1075–1078. [CrossRef]
10. Rhoten, D.; Parker, A. Risks and rewards of an interdisciplinary research path. *Science* **2004**, *306*, 2046. [CrossRef]
11. Qin, J.; Lancaster, F.W.; Allen, B. Types and levels of collaboration in interdisciplinary research in the sciences. *J. Am. Soc. Inf. Sci.* **1997**, *48*, 893–916. [CrossRef]
12. Crane, D. Invisible colleges: Diffusion of knowledge in scientific communities. *Phys. Today* **1972**, *26*, 72. [CrossRef]
13. Clausen, T.; Fagerberg, J.; Gulbrandsen, M. Mobilizing for change: A study of research units in emerging scientific fields. *Res. Policy* **2012**, *41*, 1249–1261. [CrossRef]
14. Leahey, E.; Barringer, S.N.; Ring-Ramirez, M. Universities' structural commitment to interdisciplinary research. *Scientometrics* **2019**, *118*, 891–919. [CrossRef]
15. Karr, J.R.; Hughey, J.J.; Lee, T.K. Scientific Authorship, Collaboration, Interdisciplinarity, and Productivity. *Sci. Geneal.* **2008**, *12*, 1–5.
16. Leahey, E.; Beckman, C.M.; Stanko, T.L. Prominent but less productive: The impact of interdisciplinarity on scientists' research. *Adm. Sci. Q.* **2017**, *62*, 105–139. [CrossRef]
17. Bonaccorsi, A.; Daraio, C. Age effects in scientific productivity. *Scientometrics* **2003**, *58*, 49–90. [CrossRef]
18. Carayol, N.; Matt, M. Individual and collective determinants of academic scientists' productivity. *Inf. Econ. Policy* **2006**, *18*, 55–72. [CrossRef]
19. Rhoten, D.; Pfirman, S. Women in interdisciplinary science: Exploring preferences and consequences. *Res. Policy* **2007**, *36*, 56–75. [CrossRef]
20. Diamond, A.M., Jr. What is a citation worth? *J. Hum. Resour.* **1986**, *21*, 200–215.
21. Katz, J.; Hicks, D. How much is a collaboration worth? A calibrated bibliometric model. *Scientometrics* **1997**, *40*, 541–554. [CrossRef]
22. Evans, J.A. Electronic publication and the narrowing of science and scholarship. *Science* **2008**, *321*, 395–399. [CrossRef] [PubMed]
23. Aldieri, L.; Kotsemir, M.; Vinci, C.P. The impact of research collaboration on academic performance: An empirical analysis for Russian Universities. *MPRA* **2017**, *76408*. [CrossRef]

24. Zhang, L.; Sun, B.; Jiang, L.; Huang, Y. On the relationship between interdisciplinarity and impact: Distinct effects on academic and broader impact. *Res. Eval.* **2021**, *30*, 256–268. [CrossRef]
25. Shi, X.; Adamic, L.A.; Tseng, B.L.; Clarkson, G.S. The impact of boundary spanning scholarly publications and patents. *PLoS ONE* **2009**, *4*, e6547. [CrossRef] [PubMed]
26. Aldieri, L.; Kotsemir, M.; Vinci, C.P. The impact of research collaboration on academic performance: An empirical analysis for some European countries. *Socio-Econ. Plan. Sci.* **2018**, *62*, 13–30. [CrossRef]
27. Lowe, P.; Phillipson, J. Reflexive interdisciplinary research: The making of a research programme on the rural economy and land use. *J. Agric. Econ.* **2006**, *57*, 165–184. [CrossRef]
28. Stirling, A. On the economics and analysis of diversity. Sci. Policy Res. Unit (SPRU) Electron. *Work. Pap. Ser. Pap.* **1998**, *28*, 1–156.
29. Cummings, J.N.; Kiesler, S. Collaborative research across disciplinary and organizational boundaries. *Soc. Stud. Sci.* **2005**, *35*, 703–722. [CrossRef]
30. Yegros-Yegros, A.; Rafols, I.; D'este, P. Does interdisciplinary research lead to higher citation impact? The different effect of proximal and distal interdisciplinarity. *PLoS ONE* **2015**, *10*, e0135095. [CrossRef] [PubMed]
31. Larivière, V.; Gingras, Y. On the relationship between interdisciplinarity and scientific impact. *J. Am. Soc. Inf. Sci. Technol.* **2010**, *61*, 126–131. [CrossRef]
32. Wang, J.; Thijs, B.; Glänzel, W. Interdisciplinarity and impact: Distinct effects of variety, balance, and disparity. *PLoS ONE* **2015**, *10*, e0127298. [CrossRef]
33. Bird, E. Disciplining the interdisciplinary: Radicalism and the academic curriculum. *Br. J. Sociol. Educ.* **2001**, *22*, 463–478. [CrossRef]
34. Evans, H.M.; Macnaughton, J. Should medical humanities be a multidisciplinary or an interdisciplinary study? *Med. Humanit.* **2004**, *30*, 1–4. [CrossRef] [PubMed]
35. Klein, J.T. *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities*; University of Virginia Press: Charlottesville, VA, USA, 1996; pp. 154–196.
36. Cole, S. Professional standing and the reception of scientific discoveries. *Am. J. Sociol.* **1970**, *76*, 286–306. [CrossRef]
37. Hansen, W.L.; Weisbrod, B.A.; Strauss, R.P. Modeling the earnings and research productivity of academic economists. *J. Political Econ.* **1978**, *86*, 729–741.
38. Boardman, P.C.; Corley, E.A. University research centers and the composition of research collaborations. *Res. Policy* **2008**, *37*, 900–913. [CrossRef]
39. Bozeman, B.; Dietz, J.S.; Gaughan, M. Scientific and technical human capital: An alternative model for research evaluation. *Int. J. Technol. Manag.* **2001**, *22*, 716–740. [CrossRef]
40. Ponomariov, B.L.; Boardman, P.C. Influencing scientists' collaboration and productivity patterns through new institutions: University research centers and scientific and technical human capital. *Res. Policy* **2010**, *39*, 613–624. [CrossRef]
41. Sandström, U. Combining curriculum vitae and bibliometric analysis: Mobility, gender and research performance. *Res. Eval.* **2009**, *18*, 135–142. [CrossRef]
42. Moed, H.F.; Halevi, G. A bibliometric approach to tracking international scientific migration. *Scientometrics* **2014**, *101*, 1987–2001. [CrossRef]
43. Aman, V. A new bibliometric approach to measure knowledge transfer of internationally mobile scientists. *Scientometrics* **2018**, *117*, 227–247. [CrossRef]
44. Robinson-Garcia, N.; Sugimoto, C.R.; Murray, D.; Yegros-Yegros, A.; Larivière, V.; Costas, R. The many faces of mobility: Using bibliometric data to measure the movement of scientists. *J. Informetr.* **2019**, *13*, 50–63. [CrossRef]
45. Iacus, S.M.; King, G.; Porro, G. Multivariate matching methods that are monotonic imbalance bounding. *J. Am. Stat. Assoc.* **2011**, *106*, 345–361. [CrossRef]
46. SciVal Quick Reference Guide. Available online: https://p.widencdn.net/yvftvp/ACAD_RL_SV_QRG_SciVal_Quick_Reference_Guide_WEB (accessed on 27 July 2022).
47. Research Metrics Guidebook. Available online: https://elsevier.widen.net/s/chpzk57rqk/acad_rl_elsevierresearchmetricsbook_web (accessed on 27 July 2022).
48. Larivière, V.; Haustein, S.; Börner, K. Long-distance interdisciplinarity leads to higher scientific impact. *PLoS ONE* **2015**, *10*, e0122565. [CrossRef]
49. Chen, S.; Qiu, J.; Arsenault, C.; Larivière, V. Exploring the interdisciplinarity patterns of highly cited papers. *J. Informetr.* **2021**, *15*, 101124. [CrossRef]
50. Ng, D.; Litzenberg, K. Overcoming disciplinary divides in higher education: The case of agricultural economics. *Palgrave Commun.* **2019**, *5*, 26. [CrossRef]
51. Bolger, P. Delivering on the promise: How are sustainability research institutes enabling interdisciplinary research? *Int. J. Sustain. High. Educ.* **2021**, *22*, 167–189. [CrossRef]
52. Bednarek, R.; e Cunha, M.P.; Schad, J.; Smith, W. The value of interdisciplinary research to advance paradox in organization theory. In *Interdisciplinary Dialogues on Organizational Paradox: Learning from Belief and Science*; Emerald Publishing Limited, Emerald Insight: Bingley, UK, 2021; Volume 3.
53. Townsend, T.; Pisapia, J.; Razzaq, J. Fostering interdisciplinary research in universities: A case study of leadership, alignment and support. *Stud. High. Educ.* **2015**, *40*, 658–675. [CrossRef]

54. Mwitondi, K.S.; Munyakazi, I.; Gatsheni, B.N. A robust machine learning approach to SDG data segmentation. *J. Big Data* **2020**, *7*, 97. [CrossRef]
55. Alm, K.; Melén, M.; Aggestam-Pontoppidan, C. Advancing SDG competencies in higher education: Exploring an interdisciplinary pedagogical approach. *Int. J. Sustain. High. Educ.* **2021**, *22*, 1450–1466. [CrossRef]
56. Liu, Y.; Ma, J.; Song, H.; Qian, Z.; Lin, X. Chinese universities' cross-border research collaboration in the social sciences and its impact. *Sustainability* **2021**, *13*, 10378. [CrossRef]
57. Cai, Y.; Ma, J.; Chen, Q. Higher education in innovation ecosystems. *Sustainability* **2020**, *12*, 4376. [CrossRef]
58. Altbach, P.G.; Reisberg, L.; Salmi, J.; Froumin, I. (Eds.) *Accelerated Universities: Ideas and Money Combine to Build Academic Excellence*; Brill Sense: Leiden, The Netherlands, 2018; pp. 1–13.

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The Sustainable Development and Strategic Approaches for Contemporary Higher Education

Ming-Yuan Hsieh

Department of International Business, National Taichung University of Education, Taichung 403454, Taiwan; cpawisely@mail.ntcu.edu.tw; Tel.: +886-4-2218-8731

Abstract: Due to the increasing appearance of global contagious diseases such as COVID-19, the goal of this research is to directly and explicitly advance the learning motivation, interests, and performance of online course participants into developing sustainable development and strategic approaches to discover the effective solution of the research question: how to provide the most effective online courses of sustainable development strategy for contemporary higher education in order to advance the student's learning motivation, confidence, and desires? This is accomplished by integrating the three briefest analytical aspects of the Social Learning Theory, the main theoretical philosophies of Learning Community, and 10 core technological features to determine the most critical core determinants. Beyond the complex measured results, the most valuable conclusions were: (1) the highest Standardized Comparative Weight Scales (SCWS) was located in the Publicity Philosophy for contemporary online higher education sustainable development strategy, which meant the first hypothesis was accepted and the second and third hypotheses were denied. Hence, the Publicity Philosophy (PP) of the learning community directly and effectively advanced the contemporary online higher education sustainable development strategy for educational institutions as the best solution to the research question in order to achieve the main research objective. (2) Continuously, in detail, the PP of the learning community was directly and effectively enforced by the Professionalization Technology Feature of Course Function. This directly indicated that most online course participants focus on the professionalized technological features in the system operation, such as friendly operational platforms for easy uploads, convenient downloads of online course information, and real-time news during online courses at higher education institutions. Significantly, the aggregated technology in group discussions or teamwork assignments and the complete and fair evaluation of online course technological system can facilitate collaborative lesson preparation and lesson observation of the PP of the learning community in order to advance online course interests and learning performance to be the sustainable development strategic approach in contemporary higher education era.

Keywords: higher education sustainable development strategic approach; social learning theory (SLT); learning community (LC); factor analysis (FA); regression analysis (RA); analytical network process (ANP)

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1. Introduction

In the past, to recruit higher talent employees, many corporations have not only required college students to graduate from high-reputation universities, such as Harvard University, Massachusetts Institute of Technology, or the University of London, but also requested their transcript in order to further understand their studying situations. The mutual competition of the studying scale has been the most critical learning purpose. The learning is not for the learning knowledge; the correct answer is definitely for the learning knowledge. Significantly, the majority of parents deeply believe that the graduated diplomas and degree-certificates of high-reputation schools are directly able to allow each graduate to be recruited into the largest companies with higher salaries, but also a higher

social standing. Particularly, the majority of Asian students have desired to obtain the highest studying scales with a series of the highest and most serious of competitions. More Asian students have provided the over-qualified educational background to interview for positions at large international companies to gain the position over the bulk of other interviewees. Specifically, these huge international companies preferred to recruit these interviewees with the over-qualified educational backgrounds to ensure these recruited freshmen better contribute towards the job and their working performance. Ultimately, this vicious learning-scale-hiring circle has directly formed a mutual group of competitions. Critically, a great studying scale results in better job positions, which represents higher salaries and social levels. The student's learning, therefore, becomes one of utilitarianism. The most critical situation that has occurred thus far is that many students have not only abandoned their learning, but also further escaped from the educational institutions as there is too much mutual competition impacting their confidence, desires, and their motivation to learn. To combat the cutting off of this learning-scale-hiring circle and decrease pressure on students, more education institutions are implementing reform through the reduction of examination subjects, content, and transforming all examination questions to the multiple-choice format. Alternatively, this competition-scale-hiring circle is not effectively ended. Instead, this educational competition has gotten stranger. Approximately 35 years ago, Professor Manabu Sato of the University of Tokyo, innovatively mentioned the Learning Community ("LC") [1] in an attempt to break off this this completion-scale-hiring circle. Professor Sato indicated that the essence of learning was not to study in high-reputation schools to be accepted into famous international companies and earn more money; however, it was to strengthen self-knowledge and self-actualization to contribute to the development of society. Regarding LC, there are the three major theoretical philosophies [2]: (1) publicity philosophy, (2) democrat philosophy, and (3) eminent philosophy.

Furthermore, with the rise of wireless technologies and the resulting effect of the swift diffusion of information, many teachers, educators, and lecturers have begun to utilize these technologies to create a series of digital courses through wireless software and internet technologies, as well as computer hardware, communication, and consumer electronic (3C) devices. According to the most technological characteristics, everyone is not only freely and passively downloading and obtaining knowledge and news, but also directly and actively uploading and editing the information and knowledge from online websites and courses, such as Massive Open Online Courses ("MOOCs") [3–5], without traditional time and space restrictions. The innovative technological digital courses have forced the competing educational institutions to transform into three specific educational forms. These include: community education, where the learning responsibility is not only on the students but also the schools, teachers, parents, and other stakeholders; goaled education, where each education has a series of diversified learning applications, i.e., the mathematics class is not only for correct mathematics questions and answers, but it is for the learning of mathematic theory, models, calculation processes, etc.; correction education, where it should be to be altered to literacy education, since the corrected answer is not enough to cultivate a student's applied capacities and literacies in these complex learning circumstances. Therefore, the majority of people and students have the online and digital channels to obtain the professional knowledge without taking the traditional in-person classes in higher education institutions. Presently, there are some global contagious diseases that have appeared, such as the Severe Acute Respiratory Syndrome coronavirus (SARS) in 2002, the coronavirus pandemic in 2019 ("COVID-19"), etc. Significantly, COVID-19 has resulted in the infection of 252 million people and the death of 5.08 million people, according to the official daily updates report of the World Health Organization (WHO) at the time of publication of this research paper [4]. Due to this global mass of infectious diseases, the traditional face-to-face lecturing methods have been limited, and digital and online courses have replaced the traditional face-to-face lecturing methods through diversified 3C (computers, communications, and consumer) electronic products. Taking the global contagious diseases development into consideration, this serious circumstance

has compelled a majority of educational institutions to cease in-person teaching and to aggressively turn to online teaching to survive in the hyper-shock of the current global pandemic for their online course's sustainable development strategy [5]. Due to the rapid development of the wireless and telecommunication technologies, most people have been accustomed to obtaining knowledge and information from various forms of technology, such as their smartphone.

Taking the sustainability in education into consideration, the question "how can we provide the most effective online courses of a sustainable development strategy for contemporary higher education, in order to advance the student's learning motivation, confidence, and desires?" has played a critical mainstream concern in the related research fields [6–8]. A comprehensive review of relative studies [9–11] reveals that no published study has directly analyzed the online course learning community from an individual student, school organization, and learning community's social aspects (as shown in Figure 1) with consideration of technological features. In order to resupply this research gap, this research cross-employed the three brief analytical aspects of the Social Learning Theory ("SLT") [12], the Zone of Proximal Development ("ZPD") of Vygotsky educational scholar, and the main theoretical concepts of LC to analyze and identify these technological features in higher education online courses. This was completed in order to effectively advance the learning community to further drive or trigger the extensive online course participants' learning motivation, confidence, and desires with the aim of achieving the learning essence of each online course. Since the three briefest analytical aspects of SLT were directly analyzed, the relations among the main theoretical concepts of LC are shown in Figure 1.

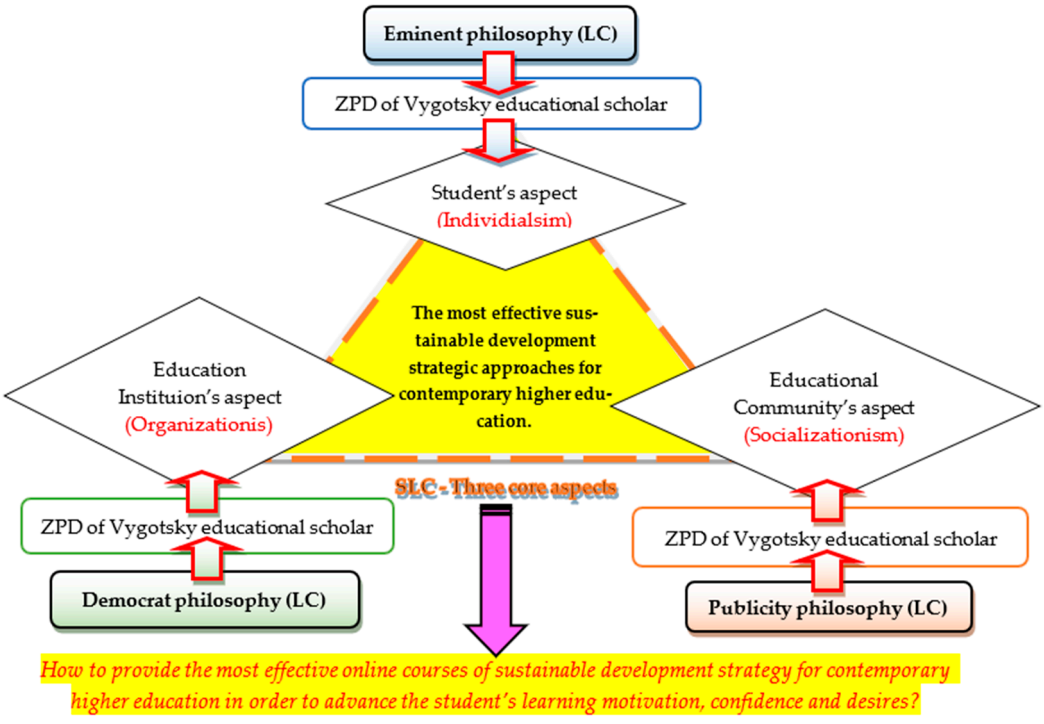

Figure 1. The main research framework.

As shown in Figure 1, the main objectives of this research was to induce the most effective learning community in contemporary online higher education sustainable development strategy in order to detect the best solutions for the research question: "how to provide the most effective online courses of sustainable development strategy for contemporary higher education in order to advance the student's learning motivation, confidence, and desires?" in consideration and association with the ZPD of Vygotsky educational scholar and main theoretical concepts of LC. There were three essential hypotheses:

First Hypothesis: the 10 core technological features in the higher education online courses directly influence the Publicity Philosophy for the most effective Contemporary Higher Education Sustainable Development Strategic Approach ("PPCHESDSA").

Second Hypothesis: the 10 core technological features in the higher education online course directly influence the most effective Democrat Philosophy for Contemporary Higher Education Sustainable Development Strategic Approach ("DPCHESDSA")?

Third Hypothesis: the 10 core technological features in the higher education online course directly influence the most effective Eminent Philosophy for Contemporary Higher Education Sustainable Development Strategic Approach ("EPCHESDSA")?

In order to evaluate the interplays and interactive dependences of the three brief analytical aspects of the SLT in Figure 1 (in terms of the statistically analytical methods), this research cross-applied the Factor Analysis ("FA") of quantitative analysis [13] and the Regression Analysis ("RA") of qualitative analysis [14] to administer the results from a large-scale questionnaire. This refined the key factors of the 10 core technological features in the online course on the contemporary online higher education sustainable development strategy with the higher research representativeness, reliability, and faithfulness. The FA of quantitative analysis was created for refining the importance and identifying the interactive dependences of evaluated factors though the large-scale questionnaires. Furthermore, the RA of quantitative analysis was induced to verify the appropriateness of the FA of quantitative analysis. Eventually, this research specifically employed the Analytical Network Process ("ANP") [15] of hierarchical qualitative analysis to construct the evaluated analytical hierarchy in order to not only hierarchically handle the results of the questionnaire from field experts, but to also systematically consolidate the measured results of the FA method of quantitative analysis and the RA of qualitative analysis with the higher research validity and professionalism [16].

2. Literature Reviews

2.1. Literature on Main Modern Concepts

According to Figure 1, the interactive relations between the three brief analytical aspects of SLT and main theoretical concepts of LC on contemporary online higher education and sustainable development strategy was designed and demonstrated in this section. In detail, the core theoretical philosophies of LC are comprised of (1) publicity philosophy, (2) democrat philosophy, and (3) eminent philosophy. Publicity philosophy signified that educational institutions such as universities, senior high schools, elementary schools, etc. were understood to be public spaces, which meant that these educational institutions must be accessible to all. Based on this publicity philosophy, Professor Sato considered that once in a year, each course of these educational institutions had to hold or implement at least one of the collaborative lesson preparations and lesson observations for the better interflow of each course. Democrat philosophy states that each principle, teacher, parent, student, and stakeholder is a master stakeholder in the educational institution. Each of these stakeholders have the right to make a statement or speech, as well as attend each association and activity related to the educational institution. Eminent philosophy denotes that each educational institution must fairly provide the prominent teaching resources, such as lecturing materials, teaching contents, etc. to each student without consideration of a student's individual condition such as studying scale and social background (i.e., family wealth). These three core philosophies of LC were integrated into the interplay triangulated relations of the initial SLC concept on the contemporary online higher education sustainable development strategy.

In detail, ref. [17] induced the learning comprehensive affected relations among individuals, organizations, and society in the learning relative research fields. Originally, the individual learning concept was directly influenced to organization learning development; organization learning development was directly impacted by the entire learning tendency. Eventually, the entire learning tendency was directly affected by individual learning concepts. On the contrary, the entire social learning tendency was indirectly led to

organization learning development, which was indirectly activated by individual learning concept, which was then indirectly dominated by the entire society learning tendency. Therefore, the three briefest analytical aspects in the interplay triangulated relations of SLT were applied to advance the main theoretical concepts of LC in online courses to advance the student's learning motivation, confidence, and desires on contemporary online higher education and sustainable development strategies.

In terms of LC, beyond the rapid development of a higher enrollment rate in Japan, the cramming education and pursuing the performance scales have resulted in the majority of students losing their organizational belongings to registered schools and learning interests of lecturing contents [18]. Therefore, Professor Manabu Sato from the University of Tokyo, Japan, addressed the brief concept of "learning community" to reform the entire education circumstance as taking not only students but also learning place, school, parents, and teachers to be as one comprehensive learning community in order to effectively raise the students' learning performance and interests through studying interflows and experience exchanges. According to the creative concept of learning community, the one-way teacher's teaching, single student's long learning, and school's cramming education ossification have been improving through better innovative educational bootstraps, which not only guided the majority of classroom students towards a happy learning experience, but also cultivated the classroom students thinking capacities to ensure them satisfied with the entire learning process and not just the studying scales. There are three philosophical statements to be understood in the learning community: (1) publicity; in which Professor Sato deemed classrooms in schools as public properties, meaning each teacher, school director, or principal must host at least one teaching observation for the public. This is because each professional teaching setting or lecture must be displayed and dis-cussed by the public [19]; (2) democracy: in which Professor Sato stated each teacher and lecturer had to respect each student, meaning the teachers or lecturers had to share their classroom power with students. This transferred the classroom spotlight from the original dynamic of teachers lecturing to one of innovation including the students learning [20]; and (3) transcendence: where all educational content and lecturing is provided for all students without discrimination of any kind, including gender, family property, social level, background evaluation, etc., which means each teacher must offer the best lecturing content possible [21]. Specifically, the lecturing materials and course structure are supposed to be designed as "moderate difficulty" for each student to efficiently raise the learning satisfaction of the most of students. Essentially, the reason for this is due to each educational institute wanting to achieve the goal of a symbiotic education, rather than a serious and competitive one. Although the cooperative learning is able to achieve the highest learning performance through team-cooperation, each team member still has to compete with each other to obtain the power as the leader in the team, which is very early in the learning variation. This is done by a reward and punishment system, whereby both systems allow for the student to learn from their success or failure, but also to allow the participating students to create a learning hierarchy based on the leader's decision or bootstrapping, which uses the team's common consensus to replace the learning equality and liberty spirit. It is an oversight that an over-emphasis on team cooperation to solve problems has transgressed the learning essence in educational subjects. The traditional education has always forced most students to pursue the studying scale without taking into consideration any kinds of enrollment processes; however, the learning community is here not only to inspire and cultivate each student, but also to provide a lecturer that can teach how to think, how to self-learn, self-regulation, and self-explore in contemporary unlimited and diversified knowledge fields. Materially, the learning community is able to directly improve the present popular cooperative learning since cooperative learning does focus on mission-oriented rewards and punishment systems to inspire the competitions between each team and indirectly restrain and strengthen leaning performance.

Hence, based on the ZPD of the Vygotsky educational scholar [22], ZPD was the difference between the student's actual development level of their learning performance and

the potential development level of learning performance according to the measured consequences. The actual development level of learning performance came from results from the student's own self-recognition learning. The potential development level of learning performance resulted in building a reflective community, jointing activity, developing higher mental function, and making sense of activities, since applying the relationship of learning and development was a dialectical unity through the learning leader's efforts. As a result, good learning leaders had to confirm each student's ZPD. The present popular cooperative learning needed a good leader or great guider to organize the common consensus of each team participant for piloting the entire team in order to achieve the missions with strong team cooperation. The learning community was supposed to make each learning activity into an interflow of ethical, cultural, and social practices, since each participated student can explore themselves in order to communicate with each other without hyper-competition relations. This self-exploration, self-dialogue, and interflow-coordination are definitely able to construct the professional knowledge, learning experience, and introspection-learning through a series of individual free will, thinking, and feeling since each participating student was directly and effectively established as a transcendent relation with the public's democrat learning practice in the learning community. Therefore, online courses are able to systematically design and create a series of subjects to supply a student's deficiency between his/her actual development level of learning performances and the potential development level of their learning performance, according to pre-course online tests and examinations through the learning community. As a result, the learning community continuously emphasized that each participating student was supposed to be self-learning and involved in mutual learning to make each participant, including school, teacher, parent, student, and learning stakeholder, obtain a series of different thinking, concept, perspective, knowledge, and experience from each different individual to confront the valuable problem, issue, and subject together. Through a succession of the reciprocal learning, interexchange listening, and interactive learning of the learning community, each participant of the learning community was able to recognize studying utility and mutual learning value, not only the cooperative relations or mutual use to achieve studying performance or problem-solving. For example, in the essence of calculated problems of the mathematic subject, the most learning students understand the mathematic concept, theory, development, and employment. This is not only in the correct answer, which means each learning community member was able to recognize the data-collection, data-explanation, thinking process of student's mathematic knowledge through student's learning procedures in order to continuously adjust mathematic lecturing materials, approaches and tendency. Eventually, the emphasis on subjective learning essence is the core of the learning community, which is the biggest difference between learning community and cooperative learning [23] on contemporary online higher education sustainable development strategy.

Eventually, in order to thoroughly discuss the research question, goals, and topics on contemporary online higher education and sustainable development strategies, the 10core technological features in the online course, based on the authors' accumulated research results [24–26], were classified as the technological features evaluated criteria. Furthermore, these 10 core technological features in the online courses were the Aggregation Technology Feature of Course Function ("ATF-CF"), Evaluation Technology Feature of Course Function ("ETF-CF"), Professionalization Technology Feature of Course Function ("PTF-CF"), Convenience of Course Operation ("C-CO"), Course Complete Rate of Course Operation ("CCR-CO"), Openness of Course Operation ("O-CO"), User Completely Unrestricted Operation of Course Operation ("UCUO-CO"), Feedback Technology Feature of Interflow Function ("FTF-IF"), Re-purposing Technology Feature of Inflow Function ("RTF-IF"), and Connectionization of Inflow Function ("C-IF").

2.2. Assessed Statistic Methods

For comprehensive measurements of the highest research reliability, validity, and accuracy, this research consolidated the FA method of quantitative analysis and RA of

qualitative analysis to managethe250 interviewee questionnaires, and then utilized the ANP of hierarchical analysis to process the expert and professional questionnaires for underscoring the research reliability and professionalism. Therefore, this session focuses on the FA method of quantitative analysis, RA of qualitative analysis, and ANP of hierarchical analysis. With reference to the highest research validity and representativeness in 250 interviewed questionnaires, the FA of quantitative analysis was employed in the first evaluated measurement since the FA of quantitative analysis was concluded to identify and classify the key determinants from a couple of related evaluated criteria or factors through a series of weighted compared computations. The brief computation of FA of quantitative analysis measured the evaluated relation weights between the dependent variables (direct observed influenced factors) defined as $Y(y_1, y_2, \ldots, y_k)$ and independent variables (direct unobserved influenced factors) presented as $X(x_1, x_2, \ldots, x_k)$. In sequences, Equation (1) [27] demonstrated to be relations between dependent variables $Y(y_1, y_2, \ldots, y_k)$ and independent variables $X(x_1, x_2, \ldots, x_k)$:

$$\begin{gathered} X(x_1, x_2, \ldots, x_k) = \mu + \Lambda f(Y(y_1, y_2, \ldots, y_k)) + \mu \\ \text{s. t. 1: standardize intersection of variance is to be 1 (maximum).} \end{gathered} \tag{1}$$

where $X(x_1, x_2, \ldots, x_k)$ was defined as a vector of observed responses, $f(Y(y_1, y_2, \ldots, y_k))$ presented a vector of common factors, and μ was identified as a vector of unique factors defined on a population. The matrix Λ was a p by k matrix of factor loadings. It is assumed that the vectors $f(Y(y_1, y_2, \ldots, y_k))$ and μ have mean zero and are uncorrelated, that the components of $f(Y(y_1, y_2, \ldots, y_k))$ have variance one, and that the components of μ were uncorrelated. The vector of μ was the mean of $X(x_1, x_2, \ldots, x_k)$.

If maximization:

$$X_k - u_k = \lambda_{k1} f_1 + \lambda_{k2} f_2 + \ldots + \lambda_{km} f_m + e_k \left(\text{s.t. } (X - u)_{-_{k\times 1}} = \wedge_{m_{k\times m}} f_{m\times 1} + e_{-_{k\times 1}} \right).$$

Variance–covariance matrix presents as:

$$\sum = \wedge \Psi \wedge^1 + \Psi_2 \Psi = diog(\Psi_1, \Psi_2, \ldots, \Psi_k)$$

After executing the FA of quantitative analysis, the RA of qualitative analysis would be further employed to prove the measured results and appropriateness of the FA for constructing a higher research reliability and accuracy. In terms of developed history, the RA of qualitative analysis was created from the method of last squares for estimating an objects track in the solar system, especially for a comet's track. Ref. [28] was a scholar who utilized FA for detecting the relationship between parent's height and children's height in social science research. Therefore, FA of qualitative analysis is a kind of analysis data in statistics for understanding the correlations, dependence, and strength between two variables (the dependent variables, $Y(y_1, y_2, \ldots, y_k)$ and independent variables, $X(x_1, x_2, \ldots, x_k)$), or among multiple variables through a construct of series of mathematic models [29].

After implementing the FA of quantitative analysis and the RA of qualitative analysis, in order to identify, refine, and advance the research accuracy and professionality of the entire cause and effect among each assessed criterion, ref. [30] employed the analytical hierarchy process ("AHP") for analyzing the one-way research subject and problem. As dealing with more complex subjects and problems, the one-way research method of AHP was completely challenged because AHP could not fully discuss the relations between each evaluated criterion. Therefore, [31] applied the results in the ANP appraised hierarchy to manage the relations between each evaluated criterion in estimated measurements through a series of pairwise-compared matrices between each evaluated criterion. The initial pairwise-compared matrices were expressed as follows:

$$A. = \begin{pmatrix} 1 - a_{1j} - a_{1n} \\ a_{i1} - a_{ij} - a_{in} \\ a_{nj} - a_{nj} - a_{1j} \end{pmatrix}_{n\times n} = \begin{pmatrix} W_1/W_1 - W_1/W_j - W_1/W_n \\ W_i/W_1 - W_1/W_1 - W_i/W_n \\ W_n/W_1 - W_n/W_1 - W_n/W_n \end{pmatrix}_{n\times n}$$

In this estimated pairwise-compared matrices, the measured weights were described as W_k and the pairwise-ratio displayed as W_i/W_j in the pairwise-compared matrices. Continuously, there were three kinds of characteristics in this pairwise-compared matrices as:

$$a_{ij} = W_i/W_j;\ a_{\max} = 1;\ for\ I = j,\ a_{ij} \times a_{ji} = 1 \tag{2}$$

Significantly, the relative pairwise weights (W ($W = [W_1, \ldots, \ldots W_j, \ldots, W_n]$) and the local priority vector w (eigenvector) of pairwise-compared matrices could be estimated by the vector quantities method (AW = nW) led from the inductive principle ($AW = \lambda_{\max}$). Furthermore, the priority vector and maximized eigenvalue were measured by the pairwise-compared matrices. As to testifying the consistency of an ANP hierarchical qualitative analysis, the two-stage algorithm was computed in Equation (3):

$$Rw = \lambda_{\max} w_i w_j = \sum_{j=1}^{m} (R_{ij} / \sum_{i=1}^{m} R_{ij})/m \tag{3}$$

Continuously, the Consistency Index (C.I.) can estimate in each pairwise-compared matrices, and the Consistency Ratio (C.R.) can further estimate through the numbers of C.I. and Random Index (R.I) computed from the estimated table of random index figure in Equation (4) [32]:

$$C.I. = (\lambda_{\max} - n)/(n-1);\ C.R. = C.I./R.I. \tag{4}$$

As the most critical flexibility of ANP hierarchical qualitative analysis, the numbers of the C.R. of each pairwise-compared matrix must be lower than 0.1, which indicates the higher evaluated consistency appearing in the evaluated measurements of each pairwise-compared matrix.

3. Research Design

Collected Questionnaires

With respect to the sample size of the collected questionnaires in the FA of quantitative analysis, [33] the first consideration was that the sample size had to be at least 100; however, [34,35] for higher research validity the ideal sample size should be between 100 to 300. Furthermore, [36] concluded that the sample size of the collected questionnaires was supposed to be more than five times greater than that of the evaluated factors in the FA of quantitative analysis for a higher research accuracy. Furthermore, [37] explored how the ideal sample size of collected questionnaires was 200 in the FA of quantitative analysis with a higher research exactness related to social science studies. For this reason, the original data size had to be designed for a total of 250 higher education online course participants in view of higher research validity and representation. The sampling technique used was the simple random sampling method [38] of probability sampling. Significantly, in terms of the research ethical regulations, the ethical review and approval of this research were waived with the exemption from trial in the social sciences. The main reasons were: (1) there was not any personally identifiable information from the interviewed participants to be released in this research; (2) all interviewees agreed with the usage-consent of their completed questionnaire information; (3) all interviewees must have been adults older than 18 years old (the adult age in Taiwanese laws); (4) there was not any intrusive surveyed measures during surveying. Therefore, a total of 250 participants were requested to participate in the survey, of which 237 agreed to complete the questionnaire. This represents a participation rate of 94.8%. A total of 91 questionnaires were completed by email. The remaining 146 questionnaires were completed in person by interview. In detail, the analytical findings are expressed in Table 1.

Table 1. The descriptive statistics of the FA method.

Gender		**Male: 131 (55.27%)**		**Female: 106 (44.73%)**	
Geography	Northern Taiwan [1]: 75 (31.64%)	Middle Taiwan [2]: 73 (30.8%)	Southern Taiwan [3]: 41 (17.29%)	Eastern Taiwan [4]: 9 (3.82%)	Foreign Countires [5]: 39 (16.45%)
How many hours have you spent on the internet	0–1: 52 (21.94%)	1–2: 82 (34.59%)	2–3: 71 (29.95%)	3–4: 27 (11.39%)	4 or more than 4 h: 5 (2.13%)
Did you learn with higher education online courses?		Yes: 199 (83.96%)		No: 38 (16.04%)	
Do you like to learn with online courses?		Yes: 203 (85.65%)		No: 34 (14.65%)	
Will you take higher education online courses in the future?		Yes: 178 (75.1%)		No: 59 (424.9%)	

[1]: Chilung, Taipei, New Taipei, and Taoyuan cities. [2]: Hsinchu, Miaoli, Taichung, and Changhua cities. [3]: Yunlin, Chiayi, Tainan, and Kaohsiung cities. [4]: Hualien and Taitung counties. [5]: Foreign countries.

In association with the academic ethic regulations and policies of the Taiwanese Ministry of Science and Technology and Ministry of Education, the collected method was in-person questionnaire fulfillment without any invasive means. The interviewed higher education students were over the age of at least 18 years and all interviewees agreed with the use of the survey.

Professionally, as [39] indicated, the experts and professionals that collected the questionnaires consisted of at least over 10 percent of the entire surveyed data, with the least errors of higher research validity and reliability in the data collection through the Delphi method. The Delphi method was induced to obtain the objective information, comments, and standpoint in the data-collection processes through the multiple experts' independent and subjective identification and decision-making. Therefore, there were 15 experts and professionals that were designed to be interviewed in person for the expert's evaluated measurements in ANP hierarchical qualitative analysis. These 15 professionals were comprised of 5 researchers with over ten years research experience in online higher education and sustainable development in relative research fields, 5 scholars with over ten years of working experience in online courses of higher education and sustainable development, and the last 5 experts were the higher education professors with over ten years in research experience in the online education diversified research fields.

4. Research Measurements

FA Systematic Approach of Quantitative Analysis

With reference to the measured equation of the FA method of quantitative analysis, Table 2 expressed that the calculated numbers of the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.786, which was larger than 0.7, and the assessed numbers of significance of the Kaiser-Meyer-Olkin measure and Barlett test was 0.000 . . . , which was lower than 0.05. As a result, the FA method of quantitative analysis was definitely suitable for measuring these 137 valid questionnaires.

Table 2. The KMO and Bartlett's Test of the FA approach of quantitative analysis.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.786
Bartlett test of sphericity	Chi-squared test	483.378
	df	12
	Significance	0.000...

Furthermore, Table 3 demonstrated the commonality of each evaluated criterion, sub-criterion, and candidate in the FA method of quantitative analysis. The commonalities of CF (Criterion) was 0.727, CO (Criterion) was 0.679, IF (Criterion) was 0.69, ATF-CF (Sub-criterion) was 0.775, PTF-CF (Sub-criterion) was 0.802, ETF-CF(Sub-criterion) was 0.771,

C-CO (Sub-criterion) was 0.674, CCR-CO (Sub-criterion) was 0.683, O-CO (Sub-criterion) was 0.649, UCUO-CO (Sub-criterion) was 0.675, FTF-IF (Sub-criterion) was 0.749, RTF-IF (Sub-criterion) was 0.695, C-IF (Sub-criterion) was 0.749, PP (Candidate) was 0.806, DP (Candidate) was 0.728, and EP (Candidate) was 0.684. In detail, based on the communalities of the FA method, there were very associated interplays and correlations between these 13 appraised criteria, sub-criteria, and candidates through measuring 137 valid extensive scale questionnaires.

Table 3. The communality KMO and Bartlett's Test of the FA approach of quantitative analysis.

Criteria, Sub-Criteria, and Candidates	Initial	Extraction
CF (Criterion)	1	0.727
CO (Criterion)	1	0.679
IF (Criterion)	1	0.69
ATF-CF (Sub-criterion)	1	0.775
PTF-CF (Sub-criterion)	1	0.802
ETF-CF(Sub-criterion)	1	0.771
C-CO (Sub-criterion)	1	0.674
CCR-CO (Sub-criterion)	1	0.683
O-CO (Sub-criterion)	1	0.649
UCUO-CO (Sub-criterion)	1	0.675
FTF-IF (Sub-criterion)	1	0.749
RTF-IF (Sub-criterion)	1	0.695
C-IF (Sub-criterion)	1	0.748
PP (Candidate)	1	0.806
DP (Candidate)	1	0.728
EP (Candidate)	1	0.684

After a succession of FA method computations, in terms of the re-search reliability and accuracy, the RA approach of qualitative analysis was further applied to these 107 extensive scale questionnaires to effectively discover the independencies and correlations among the entire appraised criteria, sub-criteria, and candidates. In Table 4, the R square of the first analytical model was 0.596, which meant 59.6% of the candidates of DP were affected by CF (Criterion), CO (Criterion), IF (Criterion), ATF-CF (Sub-criterion), PTF-CF (Sub-criterion), ETF-CF(Sub-criterion), C-CO (Sub-criterion), CCR-CO (Sub-criterion), O-CO (Sub-criterion), UCUO-CO (Sub-criterion), FTF-IF (Sub-criterion), RTF-IF (Sub-criterion), and C-IF (Sub-criterion). Subsequently, the R square of the second analytical model was 0.545, which meant 54.5% of the candidates of EP were impacted by the entire 13 criteria. Ultimately, the R third of third analytical model was 0.715, which meant that71.55% of the candidates of RDC were affected by the entire 13 criteria. The evaluated explanation of the entire criteria of CF (Criterion), CO (Criterion), IF (Criterion), ATF-CF (Sub-criterion), PTF-CF (Sub-criterion), ETF-CF(Sub-criterion), C-CO (Sub-criterion), CCR-CO (Sub-criterion), O-CO (Sub-criterion), UCUO-CO (Sub-criterion), FTF-IF (Sub-criterion), RTF-IF (Sub-criterion), and C-IF (Sub-criterion) for the three candidates' criteria of DP, EP, and PP were higher than 50%.

Table 4. The R-test of the RA of qualitative analysis.

Analytical Model	R	R Square	Adjusted R Square	Estimated Standard Error
First	0.596 (a)	0.356	0.265	0.625
Second	0.545 (b)	0.297	0.199	0.65
Third	0.715 (c)	0.512	0.444	0.587

(a) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: DP. (b) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: EP. (c) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: PP.

Subsequently, after a bulk of analyses of the variance ("ANOVA") measurements in RA, Table 5 expresses the F value of the first model, which was 3.947, and the significance was 0.000, which was lower than 0.05. Hence, the RA model was able to be employed for not only estimating but also for indicating the correlation between the candidate of DP and the entire criteria of CF (Criterion), CO (Criterion), IF (Criterion), ATF-CF (Sub-criterion), PTF-CF (Sub-criterion), ETF-CF(Sub-criterion), C-CO (Sub-criterion), CCR-CO (Sub-criterion), O-CO (Sub-criterion), UCUO-CO (Sub-criterion), FTF-IF (Sub-criterion), RTF-IF (Sub-criterion), and C-IF (Sub-criterion). Continuously, after conducting the same ANOVA measurements in the second model of RA, the F-test value was 3.027 and the significance was 0.001, which was also lower than 0.05. Therefore, the RA of the second model was suitable to be utilized for estimating and detecting the dependencies and correlations between the candidate of EP and the 13 criteria. Subsequently, after implementing the same ANOVA measurements in the third model of RA, the F-test value was 3.503 and significance was 0.000 . . . lower than 0.05 as well. As a result, the RA of third model was able to be applied for estimating and indicating the dependencies and correlations between the candidate of PP and the 13 criteria. Eventually, after carrying on the first, second, and third model of RA analysis, the RA of qualitative analysis was prepared to be employed for estimating and discovering the dependencies and correlations between the candidate of DP, EP, and PP and the 13 criteria.

Table 5. The ANOVA test of the RA of qualitative analysis.

Model		Square Sum	Freedom Degree	Sum of Average Square	F-Test	Significance
First	Regression	20.018	13	1.54	3.947	0.000 . . . (a)
	Residual	36.281	96	0.93		
	Sum	56.299	106			
Second	Regression	16.133	13	1.241	3.027	0.001 (b)
	Residual	38.129	96	0.41		
	Sum	54.262	106			
Third	Regression	33.557	13	2.581	3.503	0.000 . . . (c)
	Residual	31.994	96	0.344		
	Sum	65.551	106			

(a) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: DP. (b) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: EP. (c) Predictive Independed Variables: (constant), C-IF, CF, ETF, CF, CO, ATF-CF, O-CO, FTF-IF, UCUO-Co, C-CO, IF, CCR-CO, RTF-IF, PTF-CF; Depended variable: PP.

Based on Figure 1, after a succession of the FA of quantitative analysis and RA of qualitative analysis, the ANP of hierarchical qualitative analysis was further applied in the questionnaire's measurements from the 15 experts and professionals as illustrated in Figure 2.

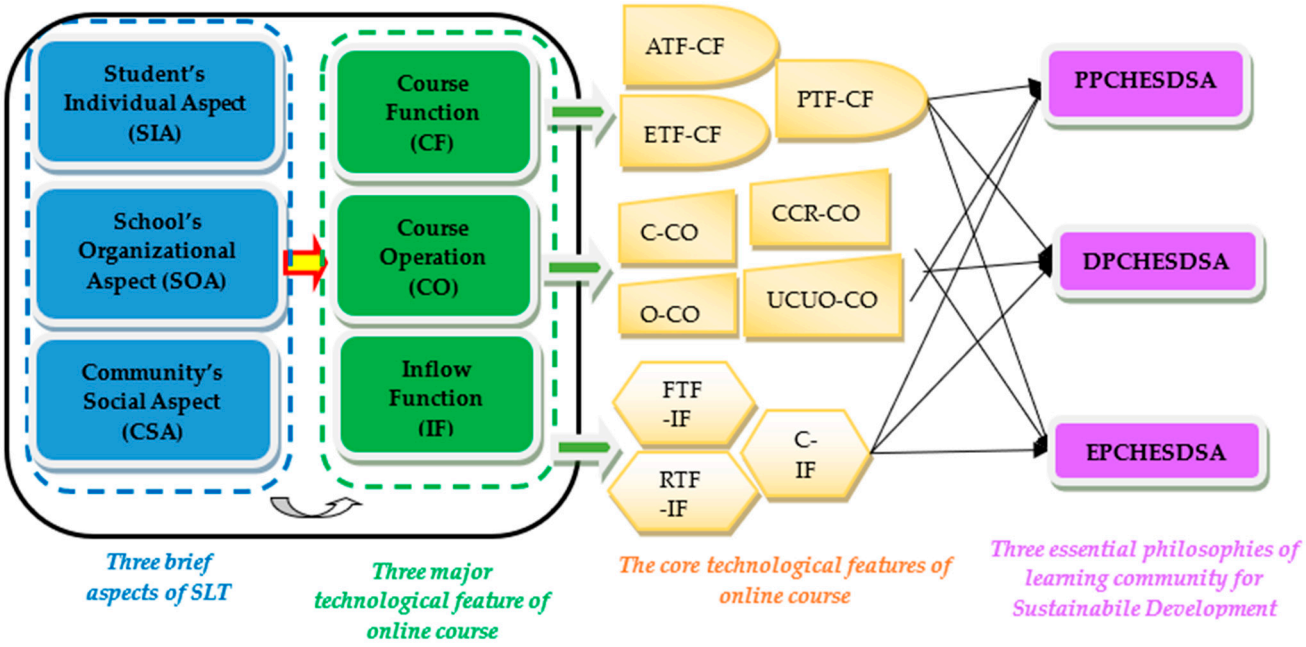

Figure 2. The ANP evaluated hierarchy.

With reference to the assessed measurements of Figure 2, the assessed pairwise-compared mix of the ANP hierarchical qualitative analysis among each appraised criterion, sub-criterion, and candidate were illustrated in Table 6. Briefly, all numbers of C.I. and C.R. of each pairwise-compared matrices were smaller than 0.1, which indicated the entire pairwise-compared matrix consisted of each appraised criterion, sub-criterion and candidate, and were higher interplays and correlations with each other in ANP hierarchical qualitative analysis.

Table 6. The entire commonalities of each assessed criterion, sub-criterion, and candidate.

Pairwise-Comparison Matrix	C.I.	C.R.
SIA	0.0368	0.0635
SOA	0.0327	0.0635
CSA	0.0523	0.0563
CF	0.0372	0.0902
CO	0.039	0.0673
IF	0.038	0.0655
ATF-CF	0.0341	0.0589
PTF-CF	0.0332	0.0572
ETF-CF	0.0287	0.0494
C-CO	0.0295	0.0509
CCR-CO	0.0212	0.0366
O-CO	0.023	0.0396
UCUO-CO	0.0303	0.0522
FTF-IF	0.0274	0.0473
RTF-IF	0.0259	0.0447
C-IF	0.0369	0.0637

In detail, Table 7 shows the assessed calculated consequences combined with the measured results of the FA method quantitative analysis into the ANP hierarchical qualitative analysis in order to achieve the higher research reliability, representation, validity, and truthfulness. Consequently and comprehensively, the highest of the SCWS was practically located in the PPCOHESDS (0.5819).

Table 7. The comprehensive evaluated measurements of the ANP hierarchical model.

					PPCHESDSA		DPCHESDSA		EPCHESDSA	
Criteria	**Communalities of FA Method**	**Weight-ANP**	**Sub-Criteria**	**Communalities of FA Method**	**Weight**	**Evaluated Score**	**Weight**	**Evaluated Score**	**Weight**	**Evaluated Score**
CF	0.727	0.5586	ATF-CF	0.775	0.5716	0.1799	0.2894	0.0911	0.139	0.0438
			PTF-CF	0.802	0.5887	0.1917	0.284	0.0925	0.1273	0.0415
			ETF-CF	0.771	0.5886	0.1843	0.2824	0.0884	0.129	0.0404
CO	0.6790	0.2857	C-CO	0.674	0.5912	0.0773	0.2733	0.0357	0.1354	0.0177
			CCR-CO	0.683	0.5928	0.0786	0.272	0.036	0.1352	0.0179
			O-CO	0.649	0.5713	0.0719	0.3043	0.0383	0.1244	0.0157
			UCUO-CO	0.675	0.5757	0.0754	0.2977	0.039	0.1266	0.0166
IF	0.6900	0.1557	FTF-IF	0.749	0.5768	0.0464	0.2944	0.0237	0.1289	0.0104
			RTF-IF	0.695	0.5689	0.0425	0.2937	0.0219	0.1374	0.0103
			C-IF	0.748	0.5788	0.0465	0.2998	0.0241	0.1214	0.0098
Standardized Comparative Weight Scales ("SCWS")						0.5819		0.2872		0.131

5. Conclusions and Recommendations

After a series of global contagious diseases and the rapid development of technologies in online courses at higher contemporary education institutions, technological online education scholars and researchers have devoted efforts to detect effective and efficient approaches to drive the student's learning motivation, interests, and performance. This research has cross-employed the three brief analytical aspects of the SLT and main theoretical concepts of LC to analyze and identify these technological features in higher education online courses to find out the most critical core determinants in order to directly and explicitly advance the learning motivation, interests, and performance of online course participants in higher education.

5.1. The Theoretical Contribution

After a series of complicated measurements in Table 7, there are the two academic contributive and empirical findings as listed below:

(1) The highest SCWS was located in the PPCHESDSA (0.5819) which means the first hypothesis was accepted and that the second and third hypotheses were denied. Hence, the publicity philosophy of learning community was direct to be the most effective sustainable development strategic approaches for contemporary higher education in order to advance the student's learning motivation, confidence and desires in order to research question in order to achieve the main research objective.

(2) In detail, the publicity philosophy of learning community was directly and effectively enforced by the professionalization technology feature of course function (PTF-CF) (0.1917). This indicates that most of online course participants focus on the professionalized technological features in system operation such as friendly operation platform for easy uploads and convenient downloads of online course information and real-time news during online courses at higher education institutions.

5.2. The Managerial Implications

Significantly, in sight of the managerial implications of the conclusion, the aggregated technology in group discussion or teamwork assignments, as well as the complete and fair evaluation of online course technological systems can facilitate collaborative lesson preparation and lesson observation of public philosophy of learning communities in order to

advance online course interests and learning performances in higher education. Therefore, higher education management must institute the educational mechanism and policies to establish the aggregated technology in group discussions or team assignments, as well as complete a fair evaluation of technological online course systems to be the most effective contemporary higher education and sustainable development strategic approach. Materially, in consideration with the theoretical contributions, this research was cross employed by the three brief analytical aspects of the SLT, the ZPD of Vygotsky educational scholar, and main theoretical concepts of LC to analyze and identify these technological features in higher education online courses. This was completed in order to effectively advance the learning community for further driving or triggering of the extensive online course participants learning motivation, confidence, and desires with the ultimate aim of achieving the learning essence of each online course. The statistical methods were employed to analyze and to identify these technological features in higher education online courses with a series of evaluated measurements of statistical methods, including FA of quantitative, RA of qualitative, and ANP of hierarchical qualitative analyses in order to overcome the obstacle of contemporary online higher education and sustainable development strategies. However, there were still some study limitations in this research, due to the restricted research time and resources.

5.3. Concluded Discussion

Significantly, this research was creative as the first time to directly analyze the online course learning community from an individual student, school organization, and learning community's social aspects. It did so in association with the technological features through employing the consolidation with the three brief analytical aspects of SLT, the ZPD of Vygotsky educational scholar, and main theoretical concepts of LC to analyze and identify these technological features in higher education online courses in order to resupply a series of research gaps in the sustainable development of higher education development. Through a series of empirical measurements of quantitative and qualitative analyses, the conclusion was suggested that the public philosophy of the learning community was likely to be the most effective sustainable development strategic approaches for contemporary higher education in order to advance the student's learning motivation, confidence, and desires to research questions to achieve the main research objectives.

5.4. Future Direction

Hence, two theoretical and empirical suggestions for future direction are expressed as follows:

(1) Evaluated methodology: there are still some effective educational theories, such as the educational technology and learning theory, as well as efficient evaluated methods, such as the technique for order preference by similarity to ideal solution (TOPSIS), to be able to further improve the research analytical results with more research time and resources, which would induce more advantageous and extraordinary contributions and findings. With respect to research limitations, the number of research participants could be increased based on more research resources, support, and time.

(2) Appraised criteria: in statistics, there were still more evaluated criteria, such as learning behaviors and response from higher education online course participants and diversified online technological applications in course's construction that need to expand the future direction for re-classifying the higher education sustainable development strategic approaches.

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Institutional Review Board Statement: Ethical review and approval were waived for this study, due to all of the interviewees being older than 20 years old and the questionnaires being anonymous.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available on request due to restrictions e.g., privacy or ethical.

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Conflicts of Interest: The author declares no conflict of interest.

Abbreviations

LC	**Learning Community**
3C	Computer, Communication, and Consumer Electronic
MOOCs	Massive Open Online Courses
COVID-19	Coronavirus disease 2019
SLT	Social Learning Theory
FA	Factor Analysis
RA	Regression Analysis
ANOVA	Analysis of Variance
AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
ATF-CF	Aggregation Technology Feature of Course Function
ETF-CF	Evaluation Technology Feature of Course Function
PTF-CF	Professionalization Technology Feature of Course Function
C-CO	Convenience of Course Operation
CCR-CO	Course Complete Rate of Course Operation
O-CO	Openness of Course Operation
UCUO-CO	User Completely Unrestricted Operation of Course Operation
FTF-IF	Feedback Technology Feature of Interflow Function
RTF-IF	Repurposing Technology Feature of Inflow Function
C-IF	Connectionization of Inflow Function
PPCOHESDS	Publicity Philosophy for Contemporary Online Higher Education Sustainable Development Strategy
DPCOHESDS	Democrat Philosophy for Contemporary Online Higher Education Sustainable Development Strategy
EPCOHESDS	Eminent Philosophy for Contemporary Online Higher Education Sustainable Development Strategy
SCWS	Standardized Comparative Weight Scales

References

1. Hord, S.M. Professional learning communities: An Overview. In *Learning Together, Leading Together: Changing Schools through Learning Community*; Hord, S.M., Ed.; Teachers College Press: New York, NY, USA, 2004; pp. 5–14.
2. Voelkel, R.H.; Chrispeels, J.H. Within-school differences in professional learning community effectiveness. *J. Sch. Leadersh.* **2017**, *27*, 421–451. Available online: https://www.academia.edu/40959267/Within_School_Differences_in_Professional_Learning_Community_Effectiveness_Implications_for_Leadership (accessed on 1 March 2021).
3. Hsieh, Y.-M. Online learning era: Exploring the most decisive determinants of MOOCs in Taiwanese higher education. *Eurasia J. Math. Sci. Technol. Educ.* **2016**, *12*, 1163–1188. [CrossRef]
4. Segovia García, N. Quality criteria of a Massive Open Online Course (MOOC) based on students assessment. *Bordón Rev. Pedagog.* **2021**, *73*, 145–160. [CrossRef]
5. Napier, A.; Huttner-Loan, E.; Reich, J. Evaluating learning transfer from MOOCs to workplaces: A case study from teacher education and launching innovation in schools. *RIED Rev. Iberoam. Educ. Distancia* **2020**, *23*, 45–64. Available online: https://www.redalyc.org/journal/3314/331463171003/331463171003.pdf (accessed on 7 March 2021).
6. Venkataraman, B. Education for Sustainable Development. *Environ. Sci. Policy Sustain. Dev.* **2009**, *51*, 8–10. [CrossRef]
7. Alam, G.M.A.; Forhad, M.A.R. Sustainable achievement of selective KPIs of different players in education: An update for policy discourse and role of tertiary education. *Int. J. Learn. Chang.* **2022**, *14*, 137–158. [CrossRef]
8. Alam, G.M.A. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef]
9. Perez-Lopez, E.; Atochero, A.V.; Rivero, S.C. Distance Education in COVID-19's period: An Analysis from the perspective of university students. *RIED-Rev. Iberoam. Educ. Distancia* **2021**, 331–350. Available online: https://scholar.google.com/citations?user=WwWeE_4AAAAJ&hl=en (accessed on 14 March 2021).

10. Salas-Rueda, R.A.; Castañeda-Martínez, R.; Eslava-Cervantes, A.L.; Alvarado-Zamorano, C. Teachers' perception about MOOCs and ICT during the COVID-19 pandemic. *Contemp. Educ. Technol.* **2022**, *14*, 343. Available online: https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-1614518 (accessed on 22 March 2021). [CrossRef]
11. Hsieh, Y.-M.; Usak, M. High Education Radical Transformation Era: How Teachers' Competency can Enhance the Students' Employability. *Rev. Cercet. Interv. Soc. RCIS Rev. Res. Soc. Interv.* **2020**, *68*, 95–112. [CrossRef]
12. Hsu, T.C.; Chang, S.C.; Hung, Y.T. How to learn and how to teach computational thinking: Suggestions based on a review of the literature. *Comput. Educ.* **2018**, *126*, 296. [CrossRef]
13. Hsieh, M.-Y. Employing MCDM methodology to verify correlationship between social media and service quality in the dynamic m-commerce era. *J. Internet Technol.* **2018**, *19*, 225–239. [CrossRef]
14. Huang, Y.-M.; Hsieh, M.-Y. An Interdisciplinary Research on Students' Employability in Technology Education to Advance Higher Education Enrollment Sustainability. *Sustainability* **2020**, *12*, 1806. [CrossRef]
15. Creswell, J.W.; Plano Clark, V.L. *Designing and Conducting Mixed Methods Research*; Sage: Thousand Oaks, CA, USA, 2007.
16. Tashakkori, A.; Teddlie, C. *Mixed Methodology: Combining Qualitative and Quantitative Approaches*; Sage Publications: Thousand Oaks, CA, USA, 1998.
17. Churchill, S.A.; Ugur, M.; Yew, S.L. Does government size affect per-capita income growth? A hierarchical meta-regression analysis. *Econ. Rec.* **2017**, *93*, 142–171. Available online: https://rest.neptune-prod.its.unimelb.edu.au/server/api/core/bitstreams/b8f78ce8-67e4-545c-8c4f-3b68e8d623b4/content (accessed on 25 March 2021). [CrossRef]
18. Hsieh, M.-Y. Interdisciplinarily Exploring the Most Potential IoT Technology Determinants in the Omnichannel E-Commerce Purchasing Decision-Making Processes. *Appl. Sci.* **2020**, *10*, 603. [CrossRef]
19. Johnson, C.W.; Voelkel, R.H., Jr. Developing increased leader capacity to support effective professional learning community teams. *Int. J. Leadersh. Educ.* **2021**, *24*, 313–332. [CrossRef]
20. Alles, M.; Seidel, T.; Gröschner, A. Establishing a positive learning atmosphere and conversation culture in the context of a video-based teacher learning community. *Prof. Dev. Educ.* **2019**, *45*, 250–263. [CrossRef]
21. Pow, J.W.C. Enhancing supervised teaching practice through building a virtual learning community with an interactive video database. In *Studies on Teaching and Learning*; Sivan, A., Chan, D., Wong, E., Eds.; Pearson: London, UK, 2014; pp. 77–90.
22. Sjoer, E.; Meirink, J. Understanding the complexity of teacher interaction in a teacher professional learning community. *Eur. J. Teach. Educ.* **2016**, *39*, 110–125. Available online: https://research.tudelft.nl/en/publications/understanding-the-complexity-of-teacher-interaction-in-a-teacher- (accessed on 3 January 2021). [CrossRef]
23. So, W.W.M. Quality of learning outcomes in an online video-based learning community: Potential and challenges for student teachers. *Asia-Pac. J. Teach. Educ.* **2012**, *40*, 143–158. [CrossRef]
24. Visone, J.D. A learning community of colleagues enhancing practice. *Kappa Delta Pi Rec.* **2016**, *52*, 66–70. [CrossRef]
25. Hsieh, M.-Y. The most sustainable niche principles of social-media education in a higher education contracting era. *Sustainability* **2020**, *12*, 399. [CrossRef]
26. Huang, Y.-M.; Hsieh, M.-Y.; Usak, M. A Multi-Criteria Study of Decision-Making Proficiency in Student's Employability for Multidisciplinary Curriculums. *Mathematics* **2020**, *8*, 897. [CrossRef]
27. Chan, Y.-K.; Hsieh, M.-Y.; Usak, M. A Concrete Study on Social-Media Connection of Global Literacy Abilities in MOOCs under the Dual Impacts of Lower Birth-Rate and COVID-19. *Sustainability* **2021**, *13*, 2203. [CrossRef]
28. Usak, M.; Hsieh, M.-Y.; Chan, Y.-K. A Concertizing Research on Making Higher Education Sustainability Count. *Sustainability* **2021**, *12*, 2724. [CrossRef]
29. Farebrother, R.W. Further results on the mean square error of ridge regression. *J. R. Stat. Soc. Ser. B* **1976**, *38*, 248. Available online: https://ur.booksc.me/book/28808937/d13d30 (accessed on 1 January 2021). [CrossRef]
30. Ghosal, S.; Sinha, B.; Majumder, M.; Misrad, A. Estimation of effects of nationwide lockdown for containing coronavirus infection on worsening of glycosylated haemoglobin and increase in diabetes-related complications: A simulation model using multivariate regression analysis Diabetes. *Metab. Syndr.* **2020**, *14*, 319–323. Available online: https://pubmed.ncbi.nlm.nih.gov/32298984/ (accessed on 15 January 2021). [CrossRef]
31. Duran, M.; Usak, M.; Hsieh, M.-Y.; Uygun, H. A New Perspective on Pedagogical Content Knowledge: Intellectual and Emotional Characteristics of Science Teachers. *Rev. Cercet. Si Interv. Soc. RCIS Rev. Res. Soc. Interv.* **2021**, *72*, 9–32. [CrossRef]
32. Wu, T.-L.; Hsieh, M.-Y.; Min, K.-W.; Ming-Ta Yu, M.-T.; Ho, C.-T. Use of Sensor Technologies in Online Courses in Post-COVID-19 Era. *Sens. Mater.* **2021**, *33*, 2045–2062. [CrossRef]
33. Thurston, L.L. Multiple factor analysis. *Psychol. Rev.* **1931**, *38*, 406–427. [CrossRef]
34. Comrey, A.L. *A First Course in Factor Analysis*; Academic Press: New York, NY, USA, 1973; Available online: https://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/ReferencesPapers.aspx?ReferenceID=354144 (accessed on 17 January 2021).
35. Gorsuch, R. *Factor Analysis*, 2nd ed.; Lawrence Erlbaum Associates: Hillsdale, NJ, USA, 1983; Available online: https://www.scirp.org/(S(czeh2tfqw2orz553k1w0r45))/reference/referencespapers.aspx?referenceid=1102421 (accessed on 21 January 2021).
36. Comrey, A.L.; Lee, H.B. *A First Course in Factor Analysis*, 2nd ed.; Lawrence Erlbaum: Hillsdale, NJ, USA, 1992; Available online: https://www.scirp.org/(S(czeh2tfqyw2orz553k1w0r45))/reference/ReferencesPapers.aspx?ReferenceID=1401733 (accessed on 23 January 2021).

37. Stevens, J.P. *Applied Multivariate Statistics for the Social Sciences*; Lawrence Erlbaum: Mahwah, NJ, USA, 2002; Available online: https://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/ReferencesPapers.aspx?ReferenceID=793967 (accessed on 26 January 2021).
38. O'Connor, B.P. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's map test. *Behav. Res. Methods Instrum. Comput.* **2000**, *32*, 396–402. [CrossRef]
39. Dalkey, N.; Helmer, O. An Experimental Application of the DELPHI Method to the Use of Experts. *Manag. Sci.* **1963**, *9*, 458–467. [CrossRef]

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Using Modified Delphi Study to Develop Instrument for ESG Implementation: A Case Study at an Indonesian Higher Education Institution

PoTsang B. Huang [1], Ching-Chow Yang [1], Maria Magdalena Wahyuni Inderawati [1,2,*] and Ronald Sukwadi [2]

[1] Department of Industrial and Systems Engineering, Chung Yuan Christian University, Taoyuan City 320, Taiwan
[2] Department of Industrial Engineering, Atma Jaya Catholic University of Indonesia, Jakarta 12930, Indonesia
* Correspondence: wahyuni.inderawati@atmajaya.ac.id

Abstract: Most research states that implementing environmental, social, and governance (ESG) has positive impacts. However, fewer studies have discussed ESG implementation in higher education. This study aimed to develop instruments to assess the ESG atmosphere in higher education institutions. A modified Delphi approach was employed. Experts were invited from a private higher education institution in Indonesia. A deductive study, discussion, and two stages of getting consensus from panelists were conducted. The instrument was distinguished into four types for four groups of higher education stakeholders: Students, Staff, Faculty Members, and Community Members. The I-CVIs ranged from 0.80–1.00, while the minimum values of S-CVI/Ave and S-CVI/UA were 0.98 and 0.91, respectively, meaning the content validity was excellent. The final version instrument has been tested and declared valid, reliable, and ready to be used for empirical research for universities to assess their contribution to the Sustainability Development Goals (SDGs). There are also opportunities to conduct further research on the existence of recursive and non-recursive models between factors.

Keywords: ESG model; instrument development; how to use modified Delphi method; higher education

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1. Introduction

In 2015, all United Nations (UN) members adopted the 2030 Agenda for Sustainable Development Goals (SDGs). This agenda provides 17 Sustainable Development Goals (SDGs): (1) No poverty; (2) Zero hunger; (3) Good health and well-being; (4) Quality education; (5) Gender equality; (6) Clean water and sanitation; (7) Affordable and clean energy; (8) Decent work and economic growth; (9) Industry, innovation and infrastructure; (10) Reduce inequalities; (11) Sustainable cities and communities; (12) Responsible consumption and production; (13) Climate action; (14) Life below water; (15) Life on land; (16) Peace, justice and strong institutions; and (17) Partnerships for the goals [1]. Organizations or companies around the world are expected to participate in the achievement of some or all of these goals based on their respective abilities. Previously, companies, especially financial firms, have successfully implemented environmental, social, and governance (ESG) principles to support the company's achievement and achieve SDGs simultaneously. ESG was first mentioned by the UN in 2006 when it launched the Principles for Responsible Investment (PRI) [2]. PRI suggested that investors should pay attention to other concerns rather than just focusing on profit.

Most research states that implementing ESG in financial firms has positive impacts: overall and individual ESG performance were significant positive indicators of creditworthiness as measured by credit rating [3], ESG risks have the potential to reduce financial returns, and most superannuation fund members are interested in ESG investing [4], conventional funds consider the firms in which Socially Responsible Investment (SRI) funds invest to integrate ESG criteria [5].

Higher education has been identified as the crucial driver in achieving the SDGs, believed to influence people's thoughts and actions, and plays an essential role in creating public awareness regarding the consequences and impact of unsustainability action on society [6,7]. Many higher education institutions have achieved the SDGs using their respective strategies. Universities conduct many activities related to sustainability, including environmental issues [8–14], social issues [9,15–19], and governance issues [14,20]. Universities can imitate the successful application of ESG principles from financial companies to contribute towards achieving the SDGs. However, fewer studies have discussed ESG implementation in higher education. One reference states that the higher education sector is early in its ESG reporting journey [21]. Another reference argues that universities must carefully plan strategies to promote a broader ESG strategy, making higher education institutions attractive to stakeholders [22]. The implementation of ESG in higher education institutions will simultaneously improve their quality. This is supported by the fact that the global higher education institution ranking conducted by Quacquarelli Symonds (QS Rank) has included the ESG indicators in the requirements [23].

Higher education in Indonesia has also begun to participate in sustainability. The University of Indonesia GreenMetric (UIGM) World University Ranking was launched in 2010. This ranking captures the latest conditions and policies related to Green Campus and Sustainability in universities worldwide [24]. The report stated that 101 higher education institutions in Indonesia participated in the UIGM, even though Indonesia has 4546 higher education institutions. This condition shows that there is still a wide gap between the number of higher education institutions concerned with sustainability and the total number of higher education institutions. Higher education in Indonesia still needs encouragement to participate in achieving the SDGs. One form of encouragement is providing references to them. A previous study has outlined the steps to becoming a sustainable university and determined the parties involved [25]. This study intended to expand knowledge of education by outlining the factors and indicators that support the implementation of ESG to achieve the SDGs. The available indicators were derived into items and formed into ready-to-use instruments. Thus, this study contributes to further research aiming to conduct empirical studies that prove the relationship between factors using this ready-to-use instrument.

2. Theory and Context of ESG

For decades, people have believed that modern businesses are responsible to their stakeholders, communities, and society. Stakeholders are increasingly looking for non-financial elements to help them make the best business decisions [26]. As a result, the organization's information must be used to reveal valuable and trustworthy information and monitor corporate officials. ESG has become a competitive component for modern organizations; therefore, ESG's responsibility to all stakeholders appears to be crucial [27]. This ESG implementation will be carried out by involving or impacting stakeholders both internally and externally.

Higher education institutions worldwide are being challenged to become more focused, efficient, and successful to meet the needs of a globalized and technologically advanced higher education market [28]. Universities adopt a business enterprise mindset to ensure survival in the face of resource constraints and rapid change in their working environment. Implementing ESG in universities is an opportunity to develop and improve the organization's quality and simultaneously contribute to achieving the SDGs.

The global disruption caused by COVID-19 has had several environmental and climate consequences. Due to movement restrictions, air quality in many cities has improved, and water pollution has decreased. Furthermore, the increased use of personal protective equipment (PPE, e.g., face masks, hand gloves, etc.), their haphazard disposal, and the generation of a large amount of hospital waste have negative environmental consequences [29]. The global COVID-19 pandemic has also forced the temporary physical closure of schools and higher education institutions. Approximately 220 million students worldwide have been

affected in higher education, presenting policymakers and educational institutions with unprecedented challenges [30]. Higher education must ensure that underrepresented, vulnerable, and disadvantaged learners are not left behind. The pandemic also emphasizes the value of university–community engagement. The pandemic has also directly impacted how universities operate and university governance, with management staff required to make various emergency decisions while allowing for additional flexibility. Those facts show that in the post-COVID-19 period, higher education needs to pay attention to environmental, social, and governance concerns.

3. Materials and Methods

The Delphi method has been proven as one of many techniques for organizing a group communication process so that a group of people can efficiently deal with a complex problem [31]. However, Gooman (1987) in Mao [32] said that a traditional Delphi method begins with an open-ended questionnaire, is time-consuming, and usually leads to a low response rate. Therefore, a study that successfully developed a tool for measuring healthcare has designed a modified Delphi method that used a structured questionnaire to ask for experts' opinions [32]. The structured questionnaire can be developed based on extensive literature reviews or a focus group interview study. This study adopted the modified Delphi method to compile the instrument. Furthermore, piloting was conducted to test the validity and reliability of the instrument to ensure that the instrument was ready to use. The research framework is shown in Figure 1, containing four steps in the modified Delphi method and one piloting step.

3.1. Stage 1: Determine Factors and Indicators

Three academics were involved in the discussion to determine what factors were related to the implementation of ESG. This discussion found that the three factors, namely Leadership, Strategy, and Performance, were closely related to the implementation of ESG. The discussion was combined with a deductive approach to corroborate the results. The following literature review has affirmed those findings.

The Sustainability Accounting Standards Board (SASB), a credible independent nonprofit organization, identifies Leadership as the factor affecting the organization's performance on ESG issues [33]. Leadership involves managing issues inherent to the business model and common practice in the organization, an essential feature in the initiation step of effective governance and important to becoming a successful world-class university [34,35]. Any organization needs strategies to achieve performance. Likewise, in the field of education, strategies are required by higher education to deal with complicated problems and the competitive knowledge marketplace that has appeared in the last decade [36,37]. A new perspective requires that the performance of nonprofit organizations is also determined by how well and efficiently they meet the needs of their stakeholders [38]. Universities have unique, measurable performance related to stakeholders, for example, satisfaction in education services received (teaching–learning service, research service, community service, administrative service, and curricular service) [39].

The proposed factors were latent variables that required measurable indicators. Therefore, the discussion continued with determining indicators. The ideas were collected from previous research. Similar arguments were grouped and given a name and identification code. Twenty-eight indicators have been found as selected indicators (Table 1). Furthermore, confirmation and consensus from the panelists were required before moving on to the following process.

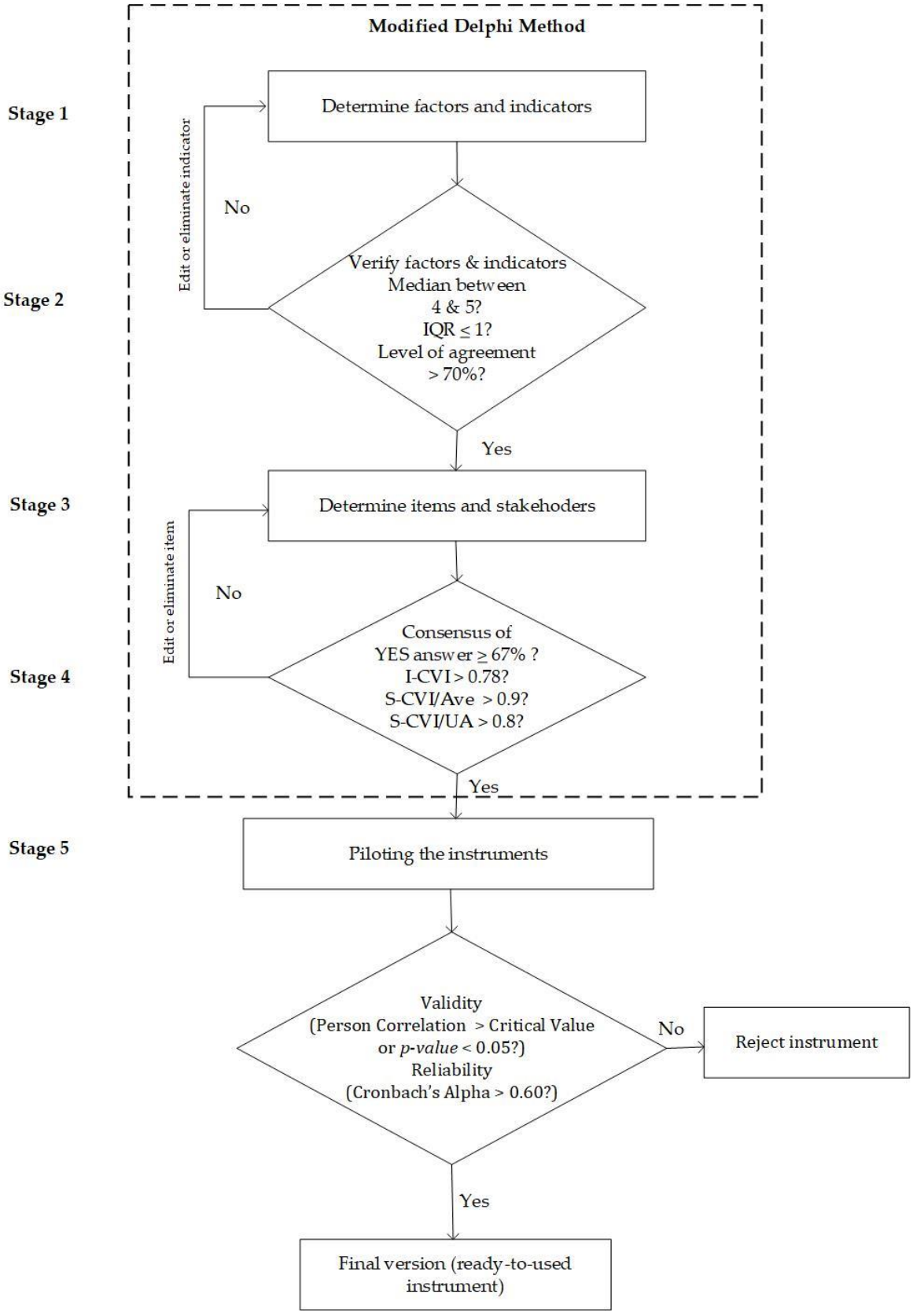

Figure 1. Research framework.

Table 1. List of proposed indicators.

Factor	Reference		Proposed Indicator	Code
	Statement	Source		
Leadership	Leadership ability is essential. Leaders can influence changes in the organization.	[40]	Rector/leader's leadership	IL1
	Universities are looking for good leaders who can advise and implement change, foster collaboration and teamwork, and act as coaches when needed	[41]		
	Leadership encourages sustainability embedding into all university areas	[14]		
	Vision and mission lead to becoming a sustainable university	[42]	Vision and mission	IL2
	Leaders use their power by using resources to affect organizational change.	[40]	Resource input	IL3
	The educational resources in higher education include student intake, qualified staff, facilities and equipment, staff–students ratio, and financial support.	[43]		
	Sustainability advocates, education, and awareness are important.	[14]	ESG Education	IL4
	Cultural differences affect leadership performance. It is recommended to use communication to build consensus within the group.	[40]	Culture and consensus	IL5
Strategies	Strategy is essential to improve a firm's ability through the execution of the mission.	[44]	Strategi for ESG	ISt1
	It is essential to create a good plan design of sustainability in higher education to avoid gaps between plan and implementation.	[45]	Plan of Strategies	ISt2
	Higher education must have a strategy to be efficient and consider stakeholders' expectations and demands.	[10]		
	Funding is crucial to becoming a successful world-class university.	[35]	Funding planning	ISt3
	Sustainability programs could become a source of money for additional upgrades.	[8]		
	How well higher education manages funding is one measure of performance.	[46]		
	Government funding was an essential driver for higher education to achieve SDGs.	[47]		
	The execution of sustainability programs is an important thing to be concerned about by the university.	[48]	Execution	ISt4
Environmental	Students must be involved in water management projects on campus.	[10]	Energy-saving (electricity and water)	IE1
	Electricity efficiency is crucial in higher education. It can increase cost-effectiveness and reduce greenhouse gas emissions. Modifying, upgrading, and maintaining electrical facilities can improve energy efficiency.	[8]		
	Universities can invest in renewable energy. Universities need to reduce environmental impact in the water area.	[14]		
	Universities need to be sensitive about energy conservation by placing signs of measure and warning.	[9]		

Table 1. *Cont.*

Factor	Reference		Proposed Indicator	Code
	Statement	Source		
	Universities can emphasize student waste reduction and recycling.	[10]	Waste reduction and recycling	IE2
	Changes in building and infrastructure to reduce energy consumption.	[11]	Green building and campus	IE3
	Universities need to have adequate greenfield.	[9]		
	Buildings must respond to climate change because buildings often have a long lifespan. Making effective selection concerning building attributes is critical to achieving sustainability goals.	[12,13,49]		
	Universities need to be concerned about a sustainable and efficient transport systems and environment friendly transport such as electric vehicles.	[10]	Transportation (bicycle, electric buses, electric cars, etc.)	IE4
	Universities need to reduce environmental impacts in the transport area.	[14]		
Social	All university members should respect human rights, cultural diversity, intercultural understanding, peace and human security, and gender equality.	[15]	People and respect	ISo1
	University Social Responsibility (USR) contributes to the effective transformation of society by resolving exclusion, inequality, and sustainability problems.	Vallaeys (2007) in [17]		
	GRI 405 highlights equal opportunities for employees regardless of gender or other relevant diversity such as minority or vulnerable groups. Concerning universities, this can also be related to equality for students.	[16]	Gender and racial equality	ISo2
	The meaning of minority can be broadened as racial differences.	[9]		
	Education in human and social values fosters civic solidarity, respect for diversity, and equal opportunities among students.	[18]	Social values education	ISo3
	Social values indicate changes in the lives of individuals or groups using tangible and intangible resources by social actors, which creates social change in society.	[19]		
	The meaning of vulnerable groups can be defined as disabled students or students who have economic deficiencies.	[9]	Care for weak students	ISo4
	Social relationships with firms, local communities, NGOs, and other organizations are essential.	[15]	Social relationships	ISo5
Governance	Corporate governance refers to the standardized interaction among the many players, including shareholders, management, boards of directors, employees, customers, financial institutions, regulators, and the community involved in directing and controlling private firms.	[50]	University autonomy	IG1
	Governance performance features authority, human resource development and empowerment, and information management capacity. The feature authority means that institutions have the right to make regulations, organizational mandate issues, roles, and responsibilities among management levels identified.	[34]		

Table 1. *Cont.*

Factor	Reference		Proposed Indicator	Code
	Statement	**Source**		
	Authority in the program, curriculum, and human resources is essential in higher education governance. This authority refers to academic freedom.	[20]	Academic freedom	IG2
	The faculty members have supported a clear policy to integrate sustainability into the curriculum and research in the academic area.	[14]	Professor authority	IG3
	Authority in the program and curriculum and human resources also refers to the authority of professors.	[20]		
	The ability of staff to plan, implement, monitor, and evaluate activities. Thus, internal stakeholders can influence and control the implementation of activities.	[34]	Staff empowerment	IG4
	Making sustainability initiatives visible in public is essential to sustainability governance in HEIs. Stakeholder opportunities to observe issues, positions, activities, and results.	[51]	Information transparency	IG5
Performance	The framework contains how well higher education manages its cost, how well higher education contributes to human capital formation, how well higher education contributes to innovation, and how well higher education contributes to social, cultural, and environmental development.	[46]	ESG evaluation	IP1
	Targeting and monitoring have been widely recognized for evaluating sustainability performance.	[45]		
	Success of nonprofits should be measured by how effectively and efficiently they meet the needs of their stakeholders.	[38]	– Student satisfaction – Staff satisfaction – Professor satisfaction – Social satisfaction	IP2 IP3 IP4 IP5
	Universities engage with each stakeholder according to their roles.	[14]		
	Within the scope of the university, the stakeholders involved in building a sustainable campus include internal stakeholders, namely students, faculty members/professors, staff, and external stakeholders, namely alumni, community, company, government (in this case referred to as social relations).	[52]		

3.2. Stage 2: Verify Factors and Indicators

In the Delphi method, the consensus of expert panelists must be obtained [53]. The consensus was obtained by analyzing the responses of the panelists. Nine experts have been invited to participate as panelists. Crawford & Wright [54] recommend obtaining the opinion of 5–20 experts with appropriate domain knowledge and heterogeneous background. A total of eight experts stated their willingness to be involved in this study. They were leaders from a private university in Indonesia with different backgrounds and position levels. Table 2 shows the demographics of the experts.

Table 2. Expert demographics.

Number of Experts Invited	**:**	**9**
Number of experts who expressed willingness	:	8
Position		
University level	:	Rector (1) Vice-rector (1)
Faculty level	:	Dean (2) Vice-dean (1)
Program level	:	Program chairperson (3)
Background	:	Engineering Business Social sciences Natural sciences Psychology

Panelists were asked whether the proposed indicators were appropriate to support the relevant factors. Experts responded by giving a score of 1 to 5. Table 3 explains the definition of the suitable scale.

Table 3. Suitable scale.

Score	**Scale Reference**	**Definition**
1	Most unsuitable	No relevance. It should be dropped as an item to consider.
2	Unsuitable	Insignificantly relevant to the latent variable. It has a bit of impact.
3	Moderately suitable	Maybe relevant to the latent variable.
4	Suitable	Relevant to the latent variable.
5	Very suitable	It is most relevant to the latent variable. It has a direct bearing on the latent variable.

Source: adapted from Jillson [55].

In this study, the statistical analysis was conducted by following the steps of the previous research that has successfully developed an instrument [32]. The data from panelists' opinions were inputted into SPSS (Statistical Package for the Social Scientists) software version 22.0 for Windows (IBM, Armonk, NY, USA). To obtain a consensus, measurement with a Likert scale of 1–5, the median, interquartile range (IQR), and the level of the agreement would be evaluated. The median should be between the top two measures (suitable/very suitable), the IQR should be one or less, and for the level of the agreement, the answers from the top two measures should be more than 70%.

3.3. Stage 3: Determine Items and Stakeholders

The process was continued by compiling items derived from each indicator. A total of 78 items were composed (Table 4). At the same time, the academics found the stakeholder groups mentioned most by previous studies. The stakeholder groups were Students (Stu), Staff (Sta), Faculty Members (FM), and Community Members (CM) [52,56–60]. Furthermore, a consensus from the panelists was needed to verify the suitability of the items to be asked to stakeholders.

Table 4. List of items.

Indicator Code	**Item Code**	**No**	**Item**
IL1	Le1	1	University leaders have concerns about ESG implementation.
	Le2	2	The leader gives directions for ESG implementation.
	Le3	3	The leader encourages ESG in all university areas.
IL2	Le4	4	The university's vision and mission have considered ESG.
	Le5	5	The university's mission provides a clear understanding of becoming a sustainable university.

Table 4. *Cont.*

Indicator Code	Item Code	No	Item
IL3	Le6	6	Leaders direct the use of resources (human, facilities, finance, etc.) to support ESG implementation.
	Le7	7	University policies related to the use of resources (human, facilities, funding, etc.) always consider ESG issues.
IL4	Le8	8	The university provides awareness about understanding ESG through meetings, training, or other media.
	Le9	9	I have participated in ESG awareness activities at least once.
IL5	Le10	10	University leaders encourage the ESG culture to inspire university members in carrying out daily activities.
	Le11	11	I agree with the ESG implementation in the university.
	Le12	12	ESG has inspired students, employees, and community members in their daily activities.
ISt1	St1	13	The university has established a master plan to achieve the objectives.
	St2	14	The university leaders cascade the master plan/long-term strategic plan to the annual plan/operational plan.
	St3	15	University leaders establish the master plans by considering efficiency and effectiveness.
ISt2	St4	16	The university has a master plan and operational plan regarding the implementation of ESG.
	St5	17	The university provides operational guidelines to facilitate ESG implementation.
ISt3	St6	18	The university allocates funds for activities related to ESG implementation.
	St7	19	ESG programs can be financially beneficial for universities (e.g., through efficiencies of electricity and water).
	St8	20	Funding from the government is important for universities to implement ESG.
ISt4	St9	21	University leaders have the competencies to implement ESG.
	St10	22	The university evaluates and monitors the implementation of ESG.
	St11	23	The university makes improvements to previous deficiencies or failures.
IE1	En1	24	The university promotes energy and water efficiency (e.g., put on signs, stickers, labels about energy-saving and water-saving).
	En2	25	The university uses energy-saving lights.
	En3	26	The university maintains or upgrades electronic equipment to support energy savings.
	En4	27	The university utilizes renewable energy sources (e.g., solar panels and wind power).
	En5	28	The university encourages research or ideas for the creation of renewable energy.
	En6	29	The university maintains the environment around the water area (e.g., ponds, lakes, rivers, seas).
	En7	30	The university engages its stakeholders in implementing energy and water-saving projects.
IE2	En8	31	The university provides trash bins with organic and non-organic waste separation in the campus area.
	En9	32	The university encourages respondents to reduce the use of materials that cause waste (e.g., reduce the use of paper and plastic).
	En10	33	The university sets a target regarding the reduction of using materials that cause waste (e.g., targets to reduce the use of paper and plastic).
	En11	34	The university processes organic waste into something useful.
IE3	En12	35	When constructing a new building or renovating an established one, the university considers energy savings (e.g., during the day, the room does not need lights, and windows are available to minimize air conditioning use).
	En13	36	The university implements a green roof approach building (a building's roof that is partially or entirely covered with vegetation and a growing medium).
	En14	37	The university has adequate greenfield areas.
IE4	En15	38	The university promotes the use of environmentally-friendly transportation (e.g., bicycles and electric vehicles).
	En16	39	The university provides adequate facilities for environmentally-friendly transportation users (e.g., special parking for bicycles and electric vehicles).
	En17	40	The university plans to reduce fossil-fuelled official vehicles to environmentally friendly ones (e.g., electric vehicles).
ISo1	So1	41	The university members respect human rights and strive to maintain peace and security.
ISo2	So2	42	University members respect gender equality.
	So3	43	The university members respect racial differences.
	So4	44	The university members give equal treatment to minorities and majorities (all forms of minority and majority).
ISo3	So5	45	The university provides education on human and social values to foster civic solidarity, respect for diversity, and equal opportunities among students, staff, and community members.
	So6	46	The university encourages individuals or groups to use available resources to become actors who create social change in society.
ISo4	So7	47	The university is concerned with the needs of students with disabilities.
	So8	48	The university is concerned with the needs of students who have economic deficiencies.
ISo5	So9	49	The university maintains relationships with the local community around campus.
	So10	50	The university maintains relationships with community members where service activities are carried out.
	So11	51	The university maintains relationships with NGOs or other organizations related to social activities.

Table 4. *Cont.*

Indicator Code	Item Code	No	Item
IG1	Go1	52	The university leaders have the authority to define the university's vision and mission.
	Go2	53	The university leaders have the authority to determine the university's grand design and operational plan.
	Go3	54	University leaders have the authority to provide guidance and make regulations.
	Go4	55	University leaders have to be responsible for the university's performance.
IG2	Go5	56	The study program has the freedom to determine the curriculum.
	Go6	57	The study program has the freedom to determine the research and community service roadmap.
IG3	Go7	58	In implementing the curriculum, lecturers have the flexibility to determine lecture materials and learning models.
	Go8	59	In implementing the research and community service roadmap, lecturers have the flexibility to determine their research and service activities.
	Go9	60	Lecturers have the freedom to deliver or publish ideas or opinions based on academic thoughts or research results.
IG4	Go10	61	Administrative and supporting staff are involved in preparing/planning university programs.
	Go11	62	Administrative and supporting staff are involved in implementing university programs.
	Go12	63	Administrative and supporting staff are involved in evaluating university programs.
IG5	Go13	64	University leaders disseminate university programs to all stakeholders through various means such as meetings, flyers, websites, social media, etc.
	Go14	65	University leaders disseminate university performance to all stakeholders through various means such as meetings, flyers, websites, social media, etc.
	Go15	66	The university provides opportunities for stakeholders to give input or opinions on university activities and performance.
IP1	Pe1	67	The university evaluates performance related to environmental concerns.
	Pe2	68	The university evaluates performance related to social concerns.
	Pe3	69	The university evaluates performance related to governance concerns.
IP2	Pe4	70	I am involved in university activities related to environmental conservation (saving electricity and water, reducing waste and recycling, and environmentally-friendly transportation).
	Pe5	71	I am involved in community service activities organized by the university.
	Pe6	72	I get equal treatment in non-academic activities.
	Pe7	73	I get equal treatment in academic activities.
	Pe8	74	I get enough information about the university's programs or activities related to ESG.
	Pe9	75	I get enough information about the university's performance regarding ESG.
	Pe10	76	The curriculum in my study program contains material on ESG/sustainability/corporate social responsibility or other similar terms.
	Pe11	77	I have the freedom to include ESG content in my courses.
	Pe12	78	I have the freedom to research the ESG theme.

3.4. Stage 4: Verify Items

In this stage, panelists were asked to rate the suitability of an item for a particular stakeholder group. Answers were on a scale of Yes/No. The answer YES indicated that the panelists agreed to address an item to the designated stakeholders, while the answer NO represented the converse.

The consensus was achieved when more than 67% of the panelists gave the same answer [61]. In this case, if more than 67% of the panelists answered YES, it is considered that the item was suitable for a particular stakeholder group. Items that agreed YES were retained, otherwise they were eliminated. The remaining items would become the prototype instrument aimed at specific stakeholder groups.

An analysis of the content validity index (CVI) was conducted. Content validity is an important procedure in scale development and is the degree to which an instrument has an appropriate sample of items for the measured construct [62]. Content validity was computed for each item (I-CVI) and overall scale (S-CVI), including the average (S-CVI/Ave) and the universal agreement (S-CVI/UA). I-CVI was computed as the number of experts giving YES for each item divided by the total number of experts. S-CVI/Ave was calculated by dividing the sum of the I-CVIs by the total number of items. Universal agreement (UA) was obtained by assigning a value of 1 to the item where all panelists answered YES; otherwise, they were given a value of 0. Then, S-CVI/UA was calculated by dividing the sum of UAs by the total number of items [63]. The statistical significance values for I-CVI, S-CVI/Ave, and S-CVI/UA were set at $\geq$0.78, 0.9, and 0.8, respectively [64].

3.5. Stage 5: Piloting the Instrument Prototype

Based on the verified prototype instrument for each stakeholder group, the instruments were distributed to stakeholders. The stakeholders were from the same university as the panel experts. This test was intended to reveal the instrument's reliability and validity. All tests were carried out using SPSS 22 software with $\alpha = 0.05$. Table 5 shows the decision-making rules regarding validity and reliability.

Table 5. The decision-making rules regarding validity and reliability.

Test	Decision	Purpose
Validity	Pearson's correlation > Critical value Pearson Product Moment or *p*-value < 0.05 The critical value depends on the number of samples (N), as listed in the R Product Moment Table	To confirm that the item can represent the indicator
Reliability	Cronbach's Alpha > 0.60	To confirm the consistency of the instrument

4. Results

Stage 1 found that leadership success can be measured by indicators of how a leader influences all members regarding ESG implementation through the vision and mission and utilizing available resources, socializing the ESG to become a culture and consensus among members. Strategy is crucial for implementing the mission, including the implementation of ESG. It includes financial planning and execution stages. Strategy development is needed to avoid gaps between planning and implementation. The presence of students and staff on campus greatly contributes to the environment around the campus. Therefore, the following issues are relevant to environmental concerns in the campus area: energy-saving (electricity and water), waste reduction and recycling, green campuses, and the impact of transportation systems. University activities are closely related to social relations, both on internal and external campuses. Therefore, the issue of gender and racial equality, as well as people's respect, is very close to campus life. In addition, universities should also pay attention to students who are disabled or have economic weaknesses and maintain good relations with the community. Campus governance is needed to facilitate operational activities. Therefore, universities need to have the authority to regulate it. Academic development is entrusted to the study program and lecturers to manage it. The staff has the right to contribute to and control operational activities. Likewise, stakeholders have the right to obtain accountable and transparent information. Meanwhile, to measure performance, it is necessary to evaluate the plan and implementation, as well as measure the level of satisfaction of stakeholders regarding the implementation of ESG. The measurable indicator descriptions in this study have been systematically presented in Table 1, becoming references for the items' compilation.

The data from Stage 2 was processed with SPSS and showed the results in median, IQR, and level of agreement, as shown in Table 6. The median values were in the range of 4 to 5, all IQRs were $\leq$1, and the levels of agreement were $\geq$0.70. These results indicated that all indicators were considered suitable to support the factors. The Funding planning indicator obtained the worst achievement with a median of 4, IQR of 1, and the lowest level of agreement (0.75). Even though the results were not good, they were still in the agreement range. These verified indicators were then derived to 78 items, as was done in Stage 3.

Table 6. The median, IQR, and level of agreement of items.

Factor		Indicator	Median	IQR	Level of Agreement
Leadership	IL1	Rector/leader's leadership	5	1	1
	IL2	Vision and mission	5	1	1
	IL3	Resource input	4	0	0.875
	IL4	ESG Education	4.5	1	0.875
	IL5	Culture and consensus	5	1	1
Strategy	ISt1	Strategy for ESG	4.5	1	1
	ISt2	Plan of Strategies	4.5	1	1
	ISt3	Funding planning	4	1	0.75
	ISt4	Execution	5	1	1
Environmental	IE1	Energy-saving (electricity and water)	5	1	1
	IE2	Waste reduction and recycling	5	0	1
	IE3	Green building and campus	5	0	1
	IE4	Transportation (bicycle, electric buses, electric cars, etc.)	4	1	1
Social	ISo1	People respect	5	1	1
	ISo2	Gender and racial equality	5	1	1
	ISo3	Social values education	4.5	1	1
	ISo4	Care for weak students	5	1	1
	ISo5	Social relationship	4.5	1	1
Governance	IG1	University autonomy	5	1	0.875
	IG2	Academic freedom	4.5	1	1
	IG3	Professor authority	4	1	0.875
	IG4	Staff empowerment	4.5	1	1
	IG5	Information transparency	5	1	0.875
Performance	IP1	ESG evaluation	4	1	1
	IP2	Student satisfaction	5	1	1
	IP3	Staff satisfaction	4.5	1	0.875
	IP4	Professor satisfaction	5	1	1
	IP5	Social satisfaction	4.5	1	1

The Leadership Factor, which has five indicators, was derived into twelve items. The items compiled include questions about how a leader performs concerning directing, compiling a vision and mission about ESG, utilizing resources, encouraging members to participate, increasing awareness about ESG, and making ESG an inspiration and culture for the organization. The four indicators from the Strategies Factor were derived into eleven items, including the existence of a master plan and operational plan, especially those related to ESG, financial planning, leadership competence in implementing ESG, and evaluation and improvement of ESG implementation. Four indicators in the Environmental Factor were derived into seventeen items: how the university carries out electricity and water efficiency, encourages research and utilizes renewable energy, waste management, building and greenfield areas, and the provision of facilities and encouragement towards environmentally friendly transportation. Five indicators in social factors were derived into eleven items: respect for human rights, gender, and racial equality, solidarity, concern for disabled or economically weak students, care for the community, and other social organizations. In the Governance Factor, five factors were derived into fifteen items, including the university authority in preparing the vision and mission; planning; regulation; performance; dissemination of programs and achievements to stakeholders; study programs' authority to manage curriculum and research; freedom for lecturers to apply lecture methods and materials, as well as carry out research and community service; and the involvement of supporting staff in preparing, implementing, and evaluating university programs related to ESG. Items in the performance factor involve assessing the implementation of ESG and stakeholders' satisfaction in academic and non-academic activities and services, mainly those most commonly found with the application of ESG. There were twelve items arranged.

The items were arranged to be distributed to the respondents. Therefore, the questions must be easy to understand so that respondents will have a similar understanding of them. A total of 78 items were composed (Table 4).

Table 7 shows the level of agreement of the panelists regarding the suitability of each item with stakeholder groups. Items with a level of agreement < 67% were eliminated from the list. The result shows that the number of items eliminated from each stakeholder group was as follows: Students (Stu) 23 items, Staff (Sta) 10 items, Faculty Members (FM) 3 items, and Community Members (CM) 36 items. Consequently, the remaining items for each stakeholder group were 55, 68, 75, and 42, respectively.

Table 7. The level of agreement between the items.

Indicator Code	Item Code	Level of Agreement				Indicator Code	Item Code	Level of Agreement			
		Stu	Sta	FM	CM			Stu	Sta	FM	CM
IL1	Le1	1.00	1.00	1.00	1.00	ISo1	So1	1.00	1.00	1.00	1.00
	Le2	0.60 *	1.00	1.00	0.20 *	ISo2	So2	1.00	1.00	1.00	1.00
	Le3	1.00	1.00	1.00	1.00		So3	1.00	1.00	1.00	1.00
IL2	Le4	1.00	1.00	1.00	1.00		So4	1.00	1.00	1.00	1.00
	Le5	1.00	1.00	1.00	1.00	ISo3	So5	1.00	1.00	1.00	1.00
IL3	Le6	1.00	1.00	1.00	1.00		So6	1.00	1.00	1.00	0.00 *
	Le7	0.20 *	1.00	1.00	0.00 *	ISo4	So7	1.00	1.00	1.00	0.00 *
IL4	Le8	1.00	1.00	1.00	1.00		So8	1.00	1.00	1.00	0.00 *
	Le9	1.00	1.00	1.00	1.00	ISo5	So9	1.00	1.00	1.00	0.00 *
IL5	Le10	1.00	1.00	1.00	1.00		So10	1.00	1.00	1.00	1.00
	Le11	1.00	1.00	1.00	1.00		So11	1.00	1.00	1.00	1.00
	Le12	1.00	1.00	1.00	1.00	IG1	Go1	0.00 *	1.00	1.00	0.00 *
ISt1	St1	0.00 *	1.00	1.00	0.00 *		Go2	0.00 *	1.00	1.00	0.00 *
	St2	0.80	1.00	1.00	1.00		Go3	0.00 *	1.00	1.00	0.00 *
	St3	0.20 *	0.80	1.00	0.00 *		Go4	0.00 *	1.00	1.00	0.00 *
ISt2	St4	0.80	0.80	1.00	1.00	IG2	Go5	0.00 *	0.00 *	1.00	0.00 *
	St5	0.80	1.00	1.00	1.00		Go6	0.00 *	0.00 *	1.00	0.00 *
ISt3	St6	0.80	0.80	1.00	1.00	IG3	Go7	0.00 *	0.00 *	1.00	0.00 *
	St7	1.00	0.80	1.00	0.00 *		Go8	0.00 *	0.00 *	1.00	0.00 *
	St8	0.60 *	1.00	1.00	0.00 *		Go9	0.00 *	0.00 *	1.00	0.00 *
ISt4	St9	1.00	1.00	1.00	1.00	IG4	Go10	0.00 *	1.00	0.00 *	0.00 *
	St10	1.00	1.00	1.00	1.00		Go11	0.00 *	1.00	0.00 *	0.00 *
	St11	1.00	1.00	1.00	1.00		Go12	0.00 *	1.00	0.00 *	0.00 *
IE1	En1	1.00	1.00	1.00	0.00 *	IG5	Go13	1.00	1.00	1.00	1.00
	En2	1.00	1.00	1.00	0.00 *		Go14	1.00	1.00	1.00	1.00
	En3	0.20 *	1.00	1.00	0.00 *		Go15	1.00	1.00	1.00	1.00
	En4	1.00	1.00	1.00	1.00	IP1	Pe1	1.00	1.00	1.00	0.80
	En5	0.00 *	0.40 *	1.00	0.00 *		Pe2	1.00	1.00	1.00	0.80
	En6	1.00	1.00	1.00	1.00		Pe3	1.00	1.00	1.00	0.80
	En7	1.00	0.80	1.00	1.00	IP2	Pe4	1.00	1.00	1.00	1.00
IE2	En8	1.00	1.00	1.00	0.00 *		Pe5	1.00	1.00	1.00	1.00
	En9	1.00	1.00	1.00	1.00		Pe6	1.00	1.00	1.00	1.00
	En10	0.20 *	0.80	1.00	0.00 *		Pe7	1.00	0.00 *	1.00	0.00 *
	En11	1.00	1.00	1.00	1.00		Pe8	1.00	1.00	1.00	1.00
IE3	En12	1.00	1.00	1.00	1.00		Pe9	1.00	1.00	1.00	1.00
	En13	1.00	1.00	1.00	0.00 *		Pe10	1.00	0.00 *	1.00	0.00 *
	En14	1.00	1.00	1.00	0.00 *		Pe11	0.00 *	0.00 *	1.00	0.00 *
IE4	En15	1.00	1.00	1.00	1.00		Pe12	0.00 *	0.00 *	1.00	0.00 *
	En16	1.00	1.00	1.00	0.00 *	Number of items eliminated		23	10	3	36
	En17	0.00 *	1.00	1.00	0.00 *	Number of items remaining		55	68	75	42

*: eliminated.

A prototype instrument with a list of relevant questions for each stakeholder group was generated. The result showed a consensus on all items because all levels of agreement were > 67%. Therefore, the modified Delphi survey was completed.

The process continued by analyzing the content validity index, starting with calculating I-CVI and UA for each item, as shown in Tables 8–11.

Table 8. Prototype instrument for Students (55 items).

No	Code	I-CVI	UA	No	Code	I-CVI	UA	No	Code	I-CVI	UA
1	Le1	1.00	1	20	En2	1.00	1	39	So8	1.00	1
2	Le3	1.00	1	21	En4	1.00	1	40	So9	1.00	1
3	Le4	1.00	1	22	En6	1.00	1	41	So10	1.00	1
4	Le5	1.00	1	23	En7	1.00	1	42	So11	1.00	1
5	Le6	1.00	1	24	En8	1.00	1	43	Go13	1.00	1
6	Le8	1.00	1	25	En9	1.00	1	44	Go14	1.00	1
7	Le9	1.00	1	26	En11	1.00	1	45	Go15	1.00	1
8	Le10	1.00	1	27	En12	1.00	1	46	Pe1	1.00	1
9	Le11	1.00	1	28	En13	1.00	1	47	Pe2	1.00	1
10	Le12	1.00	1	29	En14	1.00	1	48	Pe3	1.00	1
11	St2	0.80	0	30	En15	1.00	1	49	Pe4	1.00	1
12	St4	0.80	0	31	En16	1.00	1	50	Pe5	1.00	1
13	St5	0.80	0	32	So1	1.00	1	51	Pe6	1.00	1
14	St6	0.80	0	33	So2	1.00	1	52	Pe7	1.00	1
15	St7	1.00	1	34	So3	1.00	1	53	Pe8	1.00	1
16	St9	1.00	1	35	So4	1.00	1	54	Pe9	1.00	1
17	St10	1.00	1	36	So5	1.00	1	55	Pe10	1.00	1
18	St11	1.00	1	37	So6	1.00	1				
19	En1	1.00	1	38	So7	1.00	1		**Sum**	**54.20**	**51**

Table 9. Prototype instrument for Staff (68 items).

No	Code	I-CVI	UA	No	Code	I-CVI	UA	No	Code	I-CVI	UA
1	Le1	1.00	1	24	En1	1.00	1	47	So8	1.00	1
2	Le2	1.00	1	25	En2	1.00	1	48	So9	1.00	1
3	Le3	1.00	1	26	En3	1.00	1	49	So10	1.00	1
4	Le4	1.00	1	27	En4	1.00	1	50	So11	1.00	1
5	Le5	1.00	1	28	En6	1.00	1	51	Go1	1.00	1
6	Le6	1.00	1	29	En7	0.80	0	52	Go2	1.00	1
7	Le7	1.00	1	30	En8	1.00	1	53	Go3	1.00	1
8	Le8	1.00	1	31	En9	1.00	1	54	Go4	1.00	1
9	Le9	1.00	1	32	En10	0.80	0	55	Go10	1.00	1
10	Le10	1.00	1	33	En11	1.00	1	56	Go11	1.00	1
11	Le11	1.00	1	34	En12	1.00	1	57	Go12	1.00	1
12	Le12	1.00	1	35	En13	1.00	1	58	Go13	1.00	1
13	St1	1.00	1	36	En14	1.00	1	59	Go14	1.00	1
14	St2	1.00	1	37	En15	1.00	1	60	Go15	1.00	1
15	St3	0.80	0	38	En16	1.00	1	61	Pe1	1.00	1
16	St4	0.80	0	39	En17	1.00	1	62	Pe2	1.00	1
17	St5	1.00	1	40	So1	1.00	1	63	Pe3	1.00	1
18	St6	0.80	0	41	So2	1.00	1	64	Pe4	1.00	1
19	St7	0.80	0	42	So3	1.00	1	65	Pe5	1.00	1
20	St8	1.00	1	43	So4	1.00	1	66	Pe6	1.00	1
21	St9	1.00	1	44	So5	1.00	1	67	Pe8	1.00	1
22	St10	1.00	1	45	So6	1.00	1	68	Pe9	1.00	1
23	St11	1.00	1	46	So7	1.00	1		**Sum**	**66.80**	**62**

Table 10. Prototype instrument for Faculty Members (75 items).

No	Code	I-CVI	UA	No	Code	I-CVI	UA	No	Code	I-CVI	UA
1	Le1	1.00	1	26	En3	1.00	1	51	So11	1.00	1
2	Le2	1.00	1	27	En4	1.00	1	52	Go1	1.00	1
3	Le3	1.00	1	28	En5	1.00	1	53	Go2	1.00	1
4	Le4	1.00	1	29	En6	1.00	1	54	Go3	1.00	1
5	Le5	1.00	1	30	En7	1.00	1	55	Go4	1.00	1
6	Le6	1.00	1	31	En8	1.00	1	56	Go5	1.00	1
7	Le7	1.00	1	32	En9	1.00	1	57	Go6	1.00	1
8	Le8	1.00	1	33	En10	1.00	1	58	Go7	1.00	1
9	Le9	1.00	1	34	En11	1.00	1	59	Go8	1.00	1
10	Le10	1.00	1	35	En12	1.00	1	60	Go9	1.00	1
11	Le11	1.00	1	36	En13	1.00	1	61	Go13	1.00	1
12	Le12	1.00	1	37	En14	1.00	1	62	Go14	1.00	1
13	St1	1.00	1	38	En15	1.00	1	63	Go15	1.00	1
14	St2	1.00	1	39	En16	1.00	1	64	Pe1	1.00	1
15	St3	1.00	1	40	En17	1.00	1	65	Pe2	1.00	1
16	St4	1.00	1	41	So1	1.00	1	66	Pe3	1.00	1
17	St5	1.00	1	42	So2	1.00	1	67	Pe4	1.00	1
18	St6	1.00	1	43	So3	1.00	1	68	Pe5	1.00	1
19	St7	1.00	1	44	So4	1.00	1	69	Pe6	1.00	1
20	St8	1.00	1	45	So5	1.00	1	70	Pe7	1.00	1
21	St9	1.00	1	46	So6	1.00	1	71	Pe8	1.00	1
22	St10	1.00	1	47	So7	1.00	1	72	Pe9	1.00	1
23	St11	1.00	1	48	So8	1.00	1	73	Pe10	1.00	1
24	En1	1.00	1	49	So9	1.00	1	74	Pe11	1.00	1
25	En2	1.00	1	50	So10	1.00	1	75	Pe12	1.00	1
									Sum	**75.00**	**75**

Table 11. Prototype instrument for Community Members (42 items).

No	Code	I-CVI	UA	No	Code	I-CVI	UA	No	Code	I-CVI	UA
1	Le1	1.00	1	15	St9	1.00	1	29	So5	1.00	1
2	Le3	1.00	1	16	St10	1.00	1	30	So10	1.00	1
3	Le4	1.00	1	17	St11	1.00	1	31	So11	1.00	1
4	Le5	1.00	1	18	En4	1.00	1	32	Go13	1.00	1
5	Le6	1.00	1	19	En6	1.00	1	33	Go14	1.00	1
6	Le8	1.00	1	20	En7	1.00	1	34	Go15	1.00	1
7	Le9	1.00	1	21	En9	1.00	1	35	Pe1	0.80	0
8	Le10	1.00	1	22	En11	1.00	1	36	Pe2	0.80	0
9	Le11	1.00	1	23	En12	1.00	1	37	Pe3	0.80	0
10	Le12	1.00	1	24	En15	1.00	1	38	Pe4	1.00	1
11	St2	1.00	1	25	So1	1.00	1	39	Pe5	1.00	1
12	St4	1.00	1	26	So2	1.00	1	40	Pe6	1.00	1
13	St5	1.00	1	27	So3	1.00	1	41	Pe8	1.00	1
14	St6	1.00	1	28	So4	1.00	1	42	Pe9	1.00	1
									Sum	**41.40**	**39**

Calculations for S-CVI/Ave and S-CVI/UA were performed. Figure 2 presents a summary of the content validity index. The I-CVI of the included items ranged from 0.80 to 1.00, exceeding the recommended level of 0.78, implying that the content of each item was excellent (a). While (b) and (c) show that the result of S-CVI/Ave had a minimum value of 0.98, and the S-CVI/UA had a minimum value of 0.91, meaning that the results were above the recommended level of 0.9 and 0.8, respectively. Therefore, it could be concluded that the content validity of the whole scale was excellent.

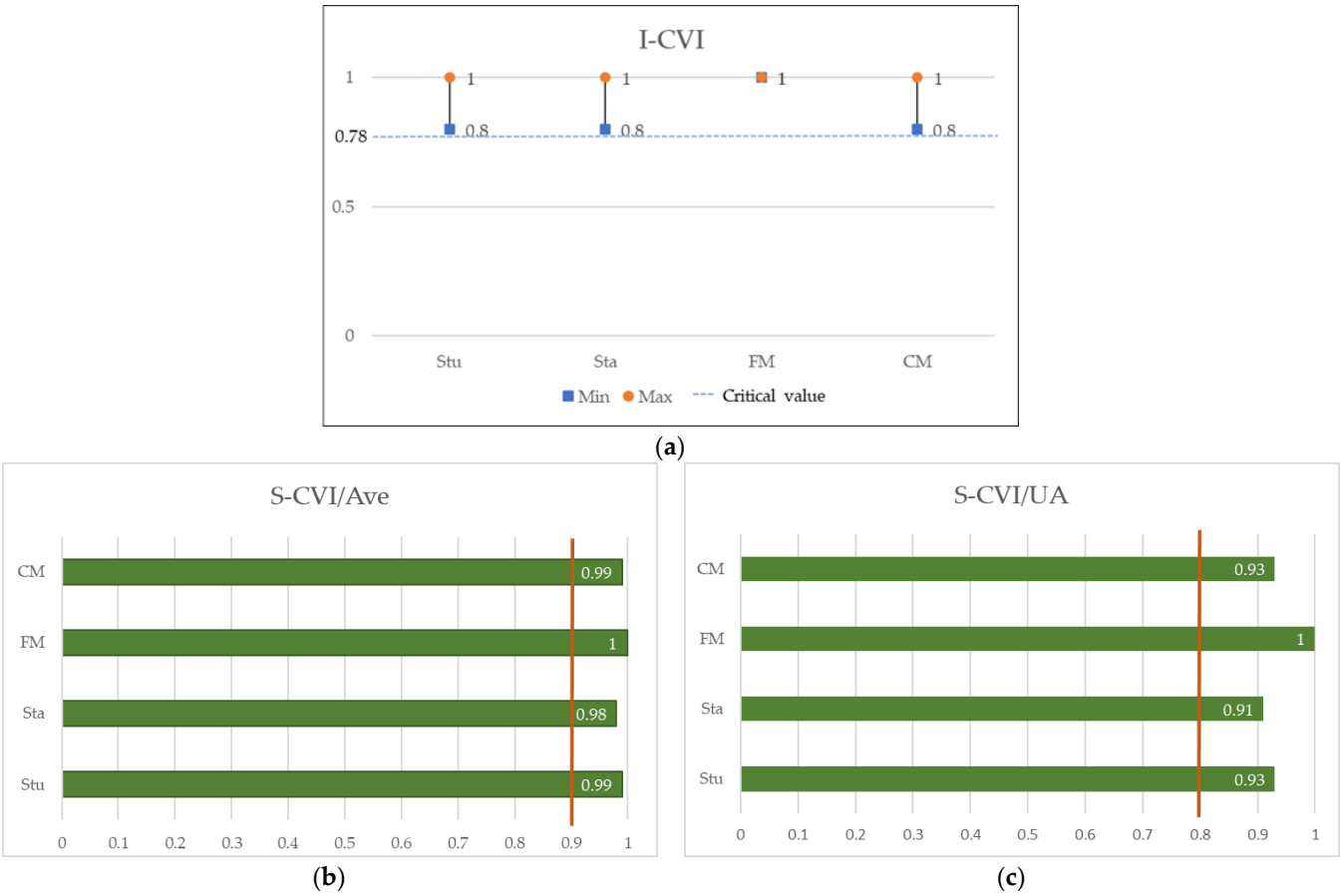

Figure 2. The content validity index. (**a**) Range of I-CVI; (**b**) Average of S-CVI; (**c**) Universal agreement.

In Stage 5, appropriate instruments were sent randomly to the group of stakeholders and received responses from 123 students, 97 staff, 80 faculty members, and 100 community members. The results of the Pearson correlation calculation were compared to the critical value in the R Product Moment Table using $\alpha = 0.05$. The results are shown in Table 12. All values of the Pearson correlation were greater than the critical value. Likewise, all *p*-values were less than 0.05. Thus, all items were valid.

Table 12. The result of the validity test.

Stakeholder Group	N	Critical Value (Pearson Product Moment)	Pearson Correlation		*p*-Value	
			Min	Max	Min	Max
Stu	123	0.177	0.600	0.872	0.00	0.00
Sta	97	0.2	0.568	0.866	0.00	0.00
FM	80	0.22	0.295	0.804	0.00	0.008
CM	100	0.197	0.555	0.840	0.00	0.00

As for the reliability test, Cronbach's Alpha results were above the critical value of 0.6 (Table 13). These results were statistically convincing that the existing instruments were consistent.

Table 13. The result of the reliability test.

Stakeholder Group	N of Respondents	N of Items	Cronbach's Alpha
Stu	123	55	0.983
Sta	97	68	0.988
FM	80	75	0.973
CM	100	42	0.977

5. Discussion

To the researchers' best knowledge, this study was the first to validate an instrument regarding ESG implementation in higher education institutions through the modified Delphi study. Instruments have been explicitly compiled aimed at higher education stakeholders, namely Students, Staff, Faculty Members, and Community Members, each of which had 55, 68, 75, and 42 items, respectively.

Although there are no standards for defining expertise, having an expert panel is essential to the Delphi technique process [65]. In the current study, the expert panelists are key persons in their position level in private higher education in Indonesia. All panelists with experience managing higher education, teaching, research, and community service activities come from different backgrounds. Their competence and diversity provided enrichment to the consensus outcome.

A consensus among the expert panelists regarding the factors and indicators considered suitable to support the factors was reached. The median range of all the included indicators was 4 to 5, and the interquartile range was 0 to 1, while the level of agreement demonstrated > 0.875, indicating good consensus.

This study has contributed to higher education by identifying factors related to ESG implementation. It was concluded that Leadership, Strategies, and Performance were the associated factors. Furthermore, twenty-eight indicators have been determined that support the factors related to ESG implementation in higher education. Five indicators support the Leadership Factor: the Rector/Leader's Leadership, Vision and Mission, Resource Input, ESG Education, and Culture and Consensus. Four indicators support the Strategies Factor: Strategy for ESG, Plan of Strategies, Funding Planning, and Execution. Four indicators support Environmental Concerns: Energy-saving (electricity and water), Waste Reduction and Recycling, Green Building and Campus, and Transportation. Five indicators support Social Concerns: People Respect, Gender and Racial Equality, Social Values Education, Care for Weak Students, and Social Relationships. Five indicators support Governance Concerns: University Autonomy, Academic Freedom, Professor Authority, Staff Empowerment, and Information Transparency. As for the Performance Factor, there are five supporting indicators: ESG Evaluation, Student Satisfaction, Staff Satisfaction, Professor Satisfaction, and Social Satisfaction.

The next stage was to compile items based on agreed indicators. Panelists were asked their opinion regarding indicators' suitability with stakeholder groups. Items that did not receive panelist approval were eliminated. Thus, the remaining items were items that have received agreement from the panelists. The items were in the form of simple questions that the respondents easily understood; therefore, the respondents were expected to provide the proper answer accurately.

The Content Validity of this study was good. The I-CVI of the included items varied from 0.80 to 1.00, which was higher than the recommended level of 0.78, suggesting that each instrument's content was excellent. The S-CVI/UA of each instrument was above 0.91, reaching the acceptable value of 0.8. Similarly, all of the S-CVI/Ave were above the proper value of 0.9, indicating the content validity of the whole scale was excellent. Higher education can use this instrument as a tool to monitor ESG implementation.

Although this study has been conducted very carefully, it is acknowledged that it has weaknesses and limitations. The deductive technique that supports the focus group discussion was used to collect as much information as possible from reliable sources;

nonetheless, it was noticeable that this study could not cover all of them. On the other hand, the invited experts were all from the same university, which did not represent the diversity of higher education options.

Despite the limitations, this study provides essential information in the form of ready-to-use instruments. Figure 3 provides a summary of what resulted from each step in this study.

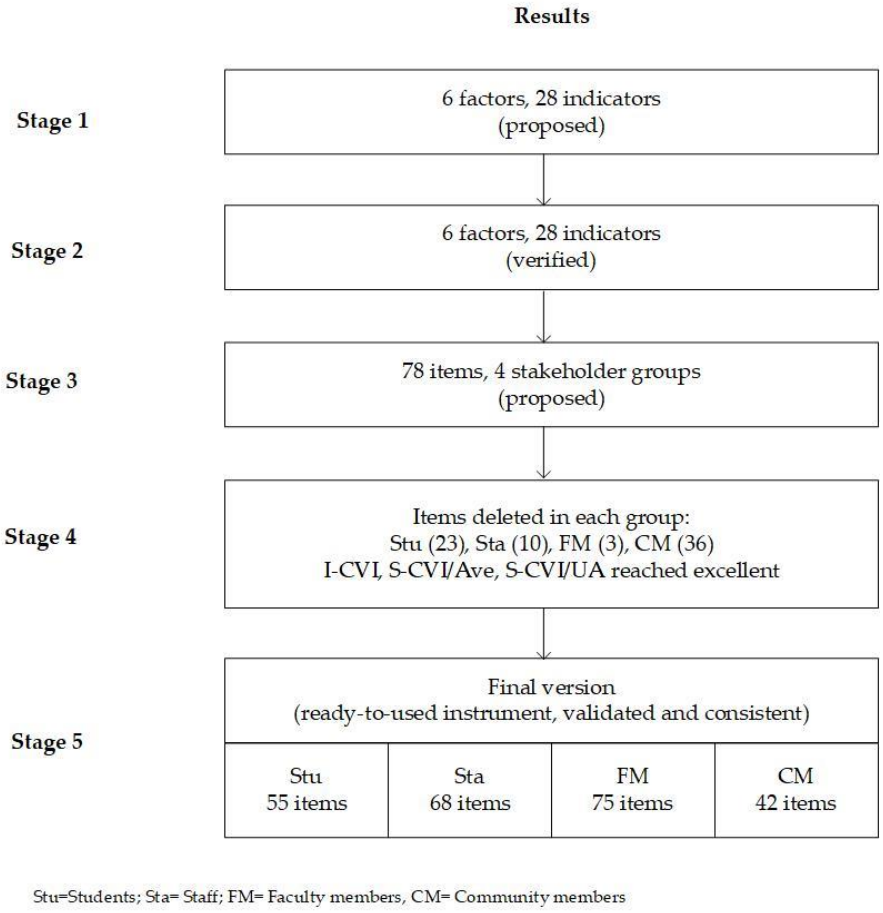

Figure 3. Results of each step.

6. Conclusions

This study has established an instrument for assessing ESG implementation in higher education. Six factors were identified: Leadership, Strategies, Environmental, Social, Governance, and Performance. The six factors were latent variables requiring measurable indicators to support them. Furthermore, twenty-eight supporting indicators have been identified. These indicators were derived into seventy-eight items in the form of simple statements.

In connection with the four stakeholder groups identified as potential respondents, an in-depth study was conducted to determine the appropriate items for each stakeholder group. Finally, it was identified that the number of items varies for each group as follows Students (55 items), Staff (68 items), Faculty Members (75 items), and Community Members (42 items).

Determination of factors, indicators, and items was performed through a deductive study, focus group discussion, and consensus-seeking from a panel of experts. The panelists were key persons in higher education management. The Modified Delphi Method was applied to obtain consensus. The questions to the panelists were not open-ended but structured questions that have been compiled based on reliable previous literature. The panel of experts reached a consensus on all items, and both the individual items and overall scale were found to have excellent content validity.

The final versions of these instruments were valid and reliable. These instruments were ready to be used to conduct empirical research in higher education that will provide information on the implementation of ESG in higher education institutions. The managerial impact is to increase the interest of higher education managers in implementing ESG to support the contribution of higher education institutions to the achievement of the SDGs. This study proposes that higher education leaders consider formulating policies, especially developing strategies related to education, implementation, and evaluation related to ESG, and assessing ESG performance as a measure of stakeholder satisfaction. In practice, higher education needs to give authority to study programs and lecturers to determine the curriculum, teaching materials, and activities related to ESG and involve students to participate.

The initiation of determining factors, indicators, and items from various reliable sources might not cover all available information. Therefore, it could become the potential weakness of this study. Likewise, panelist selection was limited to one institution. It might not be able to represent the diversity of higher education institutions. Therefore, further research can be conducted by finding information from the latest research and varied panelists. Thus, it is hoped that other factors or indicators can be found to enrich the instruments. The results of this study also provide insight for further research to prove the existence of a recursive or non-recursive model among the factors.

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References

1. 17 Goals History. Available online: https://sdgs.un.org/goals (accessed on 25 April 2022).
2. Secretary-General Launches 'Principles For Responsible Investment' Backed by World's Largest Investors. Available online: https://www.un.org/press/en/2006/sg2111.doc.htm (accessed on 17 May 2021).
3. Bhattacharya, S.; Sharma, D. Do environment, social and governance performance impact credit ratings: A study from India. *Int. J. Ethic-Syst.* **2019**, *35*, 466–484. [CrossRef]
4. De Zwaan, L.; Brimble, M.; Stewart, J. Member perceptions of ESG investing through superannuation. *Sustain. Account. Manag. Policy J.* **2015**, *6*, 79–102. [CrossRef]
5. Alda, M. The environmental, social, and governance (ESG) dimension of firms in which social responsible investment (SRI) and conventional pension funds invest: The mainstream SRI and the ESG inclusion. *J. Clean. Prod.* **2021**, *298*, 126812. [CrossRef]
6. Lambrechts, W. The contribution of sustainability assessment to policy development in higher education. *Assess. Eval. High. Educ.* **2015**, *40*, 801–816. [CrossRef]
7. Menon, S.; Suresh, M. Synergizing education, research, campus operations, and community engagements towards sustainability in higher education: A literature review. *Int. J. Sustain. High. Educ.* **2020**, *21*, 1015–1051. [CrossRef]
8. Faghihi, V.; Hessami, A.R.; Ford, D.N. Sustainable campus improvement program design using energy efficiency and conservation. *J. Clean. Prod.* **2015**, *107*, 400–409. [CrossRef]
9. Ozdemir, Y.; Kaya, S.K.; Turhan, E. A scale to measure sustainable campus services in higher education: "Sustainable Service Quality". *J. Clean. Prod.* **2020**, *245*, 118839. [CrossRef]
10. Berzosa, A.; Bernaldo, M.O.; Fernández-Sanchez, G. Sustainability assessment tools for higher education: An empirical comparative analysis. *J. Clean. Prod.* **2017**, *161*, 812–820. [CrossRef]
11. Pimentel, D.; Pleasant, A.; Barron, J.; Gaudioso, J.; Pollock, N.; Chae, E.; Kim, Y.; Lassiter, A.; Schiavoni, C.; Jackson, A.; et al. US Energy Conservation and Efficiency: Benefits and Costs. *Environ. Dev. Sustain.* **2004**, *6*, 279–305. [CrossRef]
12. Wan, K.K.; Li, D.H.; Liu, D.; Lam, J.C. Future trends of building heating and cooling loads and energy consumption in different climates. *Build. Environ.* **2011**, *46*, 223–234. [CrossRef]

13. Sailor, D.J.; Elley, T.B.; Gibson, M. Exploring the building energy impacts of green roof design decisions—A modeling study of buildings in four distinct climates. *J. Build. Phys.* **2012**, *35*, 372–391. [CrossRef]
14. Ralph, M.; Stubbs, W. Integrating environmental sustainability into universities. *High. Educ.* **2014**, *67*, 71–90. [CrossRef]
15. Albareda-Tiana, S.; Vidal-Raméntol, S.; Fernández-Morilla, M. Implementing the sustainable development goals at University level. *Int. J. Sustain. High. Educ.* **2018**, *19*, 473–497. [CrossRef]
16. GRI. *Consolidated Set of GRI Sustainability Reporting Standards 2020*; GSSB: Amsterdam, The Netherlands, 2020.
17. Santos, G.; Marques, C.S.; Justino, E.; Mendes, L. Understanding social responsibility's influence on service quality and student satisfaction in higher education. *J. Clean. Prod.* **2020**, *256*, 120597. [CrossRef]
18. Vázquez, J.L.; Aza, C.L.; Lanero, A. University social responsibility as antecedent of students' satisfaction. *Int. Rev. Public Nonprofit Mark.* **2016**, *13*, 137–149. [CrossRef]
19. Jain, P.K.; Hazenberg, R.; Seddon, F.; Denny, S. Social Value as a Mechanism for Linking Public Administrators with Society: Identifying the Meaning, Forms and Process of Social Value Creation. *Int. J. Public Adm.* **2020**, *43*, 876–889. [CrossRef]
20. Jaramillo, A.; Zaafrane, H. Benchmarking university governance in the MENA region. *J. High. Educ. Manag. Policy* **2014**, *24*, 7–36. [CrossRef]
21. Higher Education is Investing in ESG. Available online: https://info.kpmg.us/news-perspectives/advancing-the-profession/higher-ed-investing-in-esg.html (accessed on 19 September 2022).
22. ESG in Higher Education: From Strategy to Execution. Available online: https://www.ey.com/en_us/education/strategy-consulting/esg-in-higher-education-a-focus-on-the-environment (accessed on 19 September 2022).
23. Data Appendix. Available online: https://support.qs.com/hc/en-gb/articles/4405027974290-Data-Appendix (accessed on 28 April 2022).
24. UI GreenMetric World University Rankings: Background of The Ranking. Available online: https://greenmetric.ui.ac.id/about/welcome (accessed on 28 April 2022).
25. Jusuf, E.; Herwany, A.; Kurniawan, P.S.; Gunardi, A. Sustainability Concept Implementation in Higher Education Institutions of Indonesia. *J. Southwest Jiaotong Univ.* **2020**, *55*, 1–18. [CrossRef]
26. Hoang, T. *The Role of the Integrated Reporting in Raising Awareness of Environmental, Social and Corporate Governance (ESG) Performance, in Stakeholders, Governance and Responsibility*; Emerald Publishing Limited: Bradford, UK, 2018; pp. 47–69.
27. Taliento, M.; Favino, C.; Netti, A. Impact of Environmental, Social, and Governance Information on Economic Performance: Evidence of a Corporate 'Sustainability Advantage' from Europe. *Sustainability* **2019**, *11*, 1738. [CrossRef]
28. Harding, S.; Harrison, R. Changing Times, Changing Universities: Leadership, Governance and Management in a Dynamic Environment. *Int. J. Chin. Educ.* **2015**, *4*, 5–27. [CrossRef]
29. Rume, T.; Islam, S.D.-U. Environmental effects of COVID-19 pandemic and potential strategies of sustainability. *Heliyon* **2020**, *6*, e04965. [CrossRef] [PubMed]
30. Farnell, T.; Matijević, A.S.; Schmidt, N.Š. *The Impact of COVID-19 on Higher Education: A Review of Emerging Evidence: Analytical Report*; European Commission, Directorate-General for Education, Youth, Sport and Culture: Brussel, Belgium, 2021.
31. Linstone, H.A.; Turoff, M. *The Delphi Method: Techniques and Applications*; Addison-Wesley Publishing Company, Advanced Book Program: Boston, MA, USA, 2002.
32. Mao, X.; Loke, A.Y.; Hu, X. Developing a tool for measuring the disaster resilience of healthcare rescuers: A modified Delphi study. *Scand. J. Trauma, Resusc. Emerg. Med.* **2020**, *28*, 1–12. [CrossRef]
33. SASB Materiality Map. Available online: https://materiality.sasb.org/ (accessed on 3 June 2021).
34. Ehler, C.N. Indicators to measure governance performance in integrated coastal management. *Ocean Coast. Manag.* **2003**, *46*, 335–345. [CrossRef]
35. Altbach, P.; Salmi, J. *The Road to Academic Excellence: The Making of World-Class Research Universities*; Bank, T.W., Ed.; The World Bank: Washington, DC, USA, 2011.
36. Pucciarelli, F.; Kaplan, A. Competition and strategy in higher education: Managing complexity and uncertainty. *Bus. Horiz.* **2016**, *59*, 311–320. [CrossRef]
37. Demir, R.; Wennberg, K.; McKelvie, A. The Strategic Management of High-Growth Firms: A Review and Theoretical Conceptualization. *Long Range Plan.* **2017**, *50*, 431–456. [CrossRef]
38. Kaplan, R.S. Strategic Performance Measurement and Management in Nonprofit Organizations. *Nonprofit Manag. Leadersh.* **2001**, *11*, 353–370. [CrossRef]
39. Sumardi, A.A.R.F. The mediating effect of service quality and organizational commitment on the effect of management process alignment on higher education performance in Makassar, Indonesia. *J. Organ. Chang. Manag.* **2018**, *31*, 410–425. [CrossRef]
40. Northouse, P.G. *Leadership Theory and Practices*; SAGE Publication Inc.: Thousad Oaks, CA, USA, 2016.
41. Khan, H.; Matlay, H. Implementing service excellence in higher education. *Educ. Train.* **2009**, *51*, 769–780. [CrossRef]
42. Velazquez, L.; Munguia, N.; Platt, A.; Taddei, J. Sustainable university: What can be the matter? *J. Clean. Prod.* **2006**, *14*, 810–819. [CrossRef]
43. Ling, K.; Piew, T.; Lau, T.-C. The Impact of Resource Input Model of Education Quality on the Overall Students' Perceived Service Quality. *Can. Soc. Sci.* **2010**, *6*, 125–144. [CrossRef]
44. Saqib, S. The Role of Leadership in Strategy Formulation and Implementation. *Int. J. Manag. Organ. Stud.* **2012**, *1*, 32.

45. Engert, S.; Baumgartner, R.J. Corporate sustainability strategy—Bridging the gap between formulation and implementation. *J. Clean. Prod.* **2016**, *113*, 822–834. [CrossRef]
46. OECD. *Benchmarking Higher Education System Performance: Conceptual Framework and Data*; OECD: Paris, France, 2017.
47. Blasco, N.; Brusca, I.; Labrador, M. Drivers for Universities' Contribution to the Sustainable Development Goals: An Analysis of Spanish Public Universities. *Sustainability* **2021**, *13*, 89. [CrossRef]
48. Haid, M.; Albrecht, J.N.; Finkler, W. Sustainability implementation in destination management. *J. Clean. Prod.* **2021**, *312*, 127718. [CrossRef]
49. Pearlmutter, D.; Rosenfeld, S. Performance analysis of a simple roof cooling system with irrigated soil and two shading alternatives. *Energy Build.* **2008**, *40*, 855–864. [CrossRef]
50. Ansell, C.; Torfing, J. Introduction: Theories of Governance. In *Handbook on Theories of Governance*; Ansell, C., Torfing, J., Eds.; Edward Elgar Publishing: Cheltenham, UK, 2016; pp. 1–17.
51. Niedlich, S.; Bauer, M.; Doneliene, M.; Jaeger, L.; Rieckmann, M.; Bormann, I. Assessment of Sustainability Governance in Higher Education Institutions—A Systemic Tool Using a Governance Equalizer. *Sustainability* **2020**, *12*, 1816. [CrossRef]
52. Arroyo, P. A new taxonomy for examining the multi-role of campus sustainability assessments in organizational change. *J. Clean. Prod.* **2017**, *140*, 1763–1774. [CrossRef]
53. von der Gracht, H.A. Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technol. Forecast. Soc. Change* **2012**, *79*, 1525–1536. [CrossRef]
54. Crawford, M.; Wright, G. Delphi Method. In *Wiley StatsRef: Statistics Reference Online*; John and Wiley and Sons: Hoboken, NJ, USA, 2016; pp. 1–6.
55. Jillson, I.A. The National Drug-Abuse Policy Delphi: Progress Report and Findings to Date. In *The Delphi Method Techniques and Application*; Linstone, H.A., Turoff, M., Helmer, O., Eds.; Addison Wesley Publishing Company: Boston, MA, USA, 2002; pp. 119–154.
56. Naudé, P.; Ivy, J. The marketing strategies of universities in the United Kingdom. *Int. J. Educ. Manag.* **1999**, *13*, 126–136. [CrossRef]
57. Langrafe, T.D.F.; Barakat, S.R.; Stocker, F.; Boaventura, J.M.G. A stakeholder theory approach to creating value in higher education institutions. *Bottom Line* **2020**, *33*, 297–313. [CrossRef]
58. Perception on the Community Engagement of Students of Higher Education Institutions. Available online: https://ssrn.com/abstract=3664052 (accessed on 9 May 2021).
59. Benneworth, P.; Jongbloed, B.W. Who matters to universities? A stakeholder perspective on humanities, arts and social sciences valorisation. *High. Educ.* **2010**, *59*, 567–588. [CrossRef]
60. Sheila, N.A.; Zhu, C.; Kintu, M.J.; Kataike, J. Assessing higher education institutional stakeholders' perceptions and needs for community engagement: An empirical evidence from Uganda. *Heliyon* **2021**, *7*, e06612. [CrossRef] [PubMed]
61. Alexandrov, A.V.; Pullicino, P.M.; Meslin, E.M.; Norris, J.W. Agreement on Disease-Specific Criteria for Do-Not-Resuscitate Orders in Acute Stroke. *Members of the Canadian and Western New York Stroke Consortiums. Stroke* **1996**, *27*, 232–237. [CrossRef] [PubMed]
62. Shi, J.; Mo, X.; Sun, Z. Content validity index in scale development. *J. Cent. South Univ.* **2012**, *37*, 152–155. [CrossRef]
63. Rodrigues, I.B.; Adachi, J.D.; Beattie, K.A.; MacDermid, J.C. Development and validation of a new tool to measure the facilitators, barriers and preferences to exercise in people with osteoporosis. *BMC Musculoskelet. Disord.* **2017**, *18*, 540. [CrossRef]
64. Polit, D.F.; Beck, C.T.; Owen, S.V. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res. Nurs. Health* **2007**, *30*, 459–467. [CrossRef]
65. Shaw, K.L.; Brook, L.; Cuddeford, L.; Fitzmaurice, N.; Thomas, C.; Thompson, A.; Wallis, M. Prognostic indicators for children and young people at the end of life: A Delphi study. *Palliat. Med.* **2014**, *28*, 501–512. [CrossRef]

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Necessity of Post-War Renewal of University Teachers' Potential in Terms of Sustainable Development in Ukraine

Xiangfei Ma [1], Inna Gryshova [2], Iryna Koshkalda [3,*], Anastasiia Suska [4], Rymma Gryshova [2], Alona Riasnianska [3] and Olga Tupchii [4]

[1] School of Foreign Languages and Literatures, Hangzhou Dianzi University, 1158, 2nd Street, Qiantang New Area, Hangzhou 310018, China
[2] JSNU-SPbPU Institute of Engineering-Sino-Russian Institute, Jiangsu Normal University, 101 Shanghai Rd, Tongshan Qu, Xuzhou 221100, China
[3] Department of Land Management and Cadastre, State Biotechnological University, 61002 Kharkov, Ukraine
[4] Department of Woodworking Technologies and Systems Engineering of the Forest Complex, State Biotechnological University, 61002 Kharkov, Ukraine
* Correspondence: irinavit1506@gmail.com

Abstract: (1) The war in Ukraine has changed the normal life of every Ukrainian, including educators. For the fourth month, the educational process has been taking place under martial law. Thus, the task of every pedagogue and every university teacher is to start the educational process not only for the sake of knowledge, because you cannot deprive children of education, but also for the sake of psychological rehabilitation. The war has given an impetus to the radical renewal of education, particularly higher education, which determines the relevance of this study. (2) It is common knowledge that the professional pedagogical activity of a university teacher is of great significance to society. It is about the formation of a future specialist, whose level of qualification considerably affects the economic, political, social, and cultural component of the sustainable development of society, something which is especially relevant in the post-war period. (3) The research hypothesis is that renewing the potential of university teachers in the post-war period will allow the improvement of the educational process in universities, will significantly increase the level of professional training of students and will ensure the sustainable development of society. To examine this hypothesis, the professional and personal potential of teachers was studied in detail with the aim of understanding radical changes in approaches to methods, techniques, and forms of education, as well as the type and style of communication between teachers and students. (4) The research methodology comprised a survey conducted by the CAWI method using a structured questionnaire based on the respondents' place of permanent residence. The sample totality was stratified according to the regions of Ukraine where the teachers work. Teachers of Ukrainian higher education institutions took part in the study. The study sample included 350 people. The main task of the study was to analyze the potential of university teachers in the pre-war and post-war periods. The other tasks the study undertakes are to propose the concept of professional unity of students and teachers of higher educational institutions and to consider reflection as a tool; a tool which is a cross-sectional, integrating factor that structures the education system in various types of professional activity. (5) The undoubted achievement of the work is that, for the first time, the state of higher education was analyzed under war conditions and its development in the post-war period was predicted. This will aid the country's recovery and ensure the sustainable development of society in the post-war period. This study can complement and enhance the theoretical discussion and practical experience on sustainable development from the perspective of higher education.

Keywords: teacher's potential; higher education; war in Ukraine; sustainable development; professional integrity

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1. Introduction

The war in Ukraine has changed the normal life of every Ukrainian, including educators. For the fourth month, the educational process has been taking place under martial law. The task of every pedagogue and every university teacher is to start the educational process not only for the sake of knowledge, because you cannot deprive children of education, but also for the sake of psychological rehabilitation. The war gave an impetus to the radical renewal of education, particularly higher education, which determines the relevance of this study.

The professional activity of a university teacher is of great significance for society as it is about the formation of a future specialist, whose level of qualification considerably affects the economic, political, social, and cultural components of the sustainable development of society, which is especially relevant in the post-war period.

One of the important aspects of higher education in Ukraine is the quality of professional knowledge and skills of students after graduating from higher education institutions. However, today, with many higher education institutions, we observe an insufficient qualification of a significant number of young graduates of various fields of training. There are many university graduates, but there is a shortage of specialists capable of solving production and managerial tasks at a high professional level. To restore the country and ensure the sustainable development of society in the post-war period, qualified specialists are needed. Therefore, this study analyzes the problems of the higher education sector in Ukraine and the search for answers regarding ways to solve them.

In the pre-war period, the main issues of higher education in Ukraine were:

1. ineffective and archaic teaching methods, material and technical base in higher education institutions borrowed from the Soviet era;
2. an inefficient mechanism of state orders wherein the distribution of state-funded places was not focused on the recruitment needs of the real economy, but on the capabilities of higher education institutions to train specialists in relevant fields [1];
3. insufficient state funding of education;
4. disparity in financing the education system: expenses for general education make up about 80% of the total amount of financial resources allocated, while professional education make up only 20% [2].

Solving the problems of higher education specified in points 2–4 is the task of the state apparatus of the country, while the problem specified in point 1 regarding inefficient and archaic teaching methods borrowed from Soviet times is especially acute at the moment. The essence of solving this problem is in covering issues regarding both parties of these relations—a teacher and a student. From the position of a teacher, the quality of the knowledge they provide depends on their potential. From the students' perspective, in our opinion, the effectiveness of learning depends on reflection while absorbing the educational material [3].

The level of quality of the educational process in a higher educational institution is influenced not only by the professional but also by the personal potential of the teacher. It should be kept in mind that a university teacher is not only a scientist, a specialist in a certain field, but also a lecturer, that is, in his activities he combines the functions of teaching, educating, and developing students as specialists and personalities. We find the words of the prominent Ukrainian teacher V. Sukhomlynskyi very appropriate in this regard, as he said that in no trade do mistakes and failures lead to such grave consequences as in the pedagogical trade.

2. Literature Review

The peculiarity of pedagogical activity in a higher educational institution is that the teacher works with young people who, unlike schoolchildren, are more independent, progressive, and have their opinion and express it. Therefore, the teacher must be aware of what is happening in the world, and what trends are being followed among young people, that is, as they say, know "what young people live for" and be "on friendly terms"

with young people. After all, it is very important to "keep up with the times", to give students relevant modern knowledge, for example, logarithmic rulers are no longer used in mathematics, maps are not drawn by hand in cartography, instead, special programs are used, etc. Moreover, not only the method, reception, and form of education, but also the type and style of the teacher's communication with the students have a significant impact on the effectiveness of the students' assimilation of knowledge. This issue never stops being considered in pedagogical literature.

The main types of teacher–student communication are presented in Figure 1.

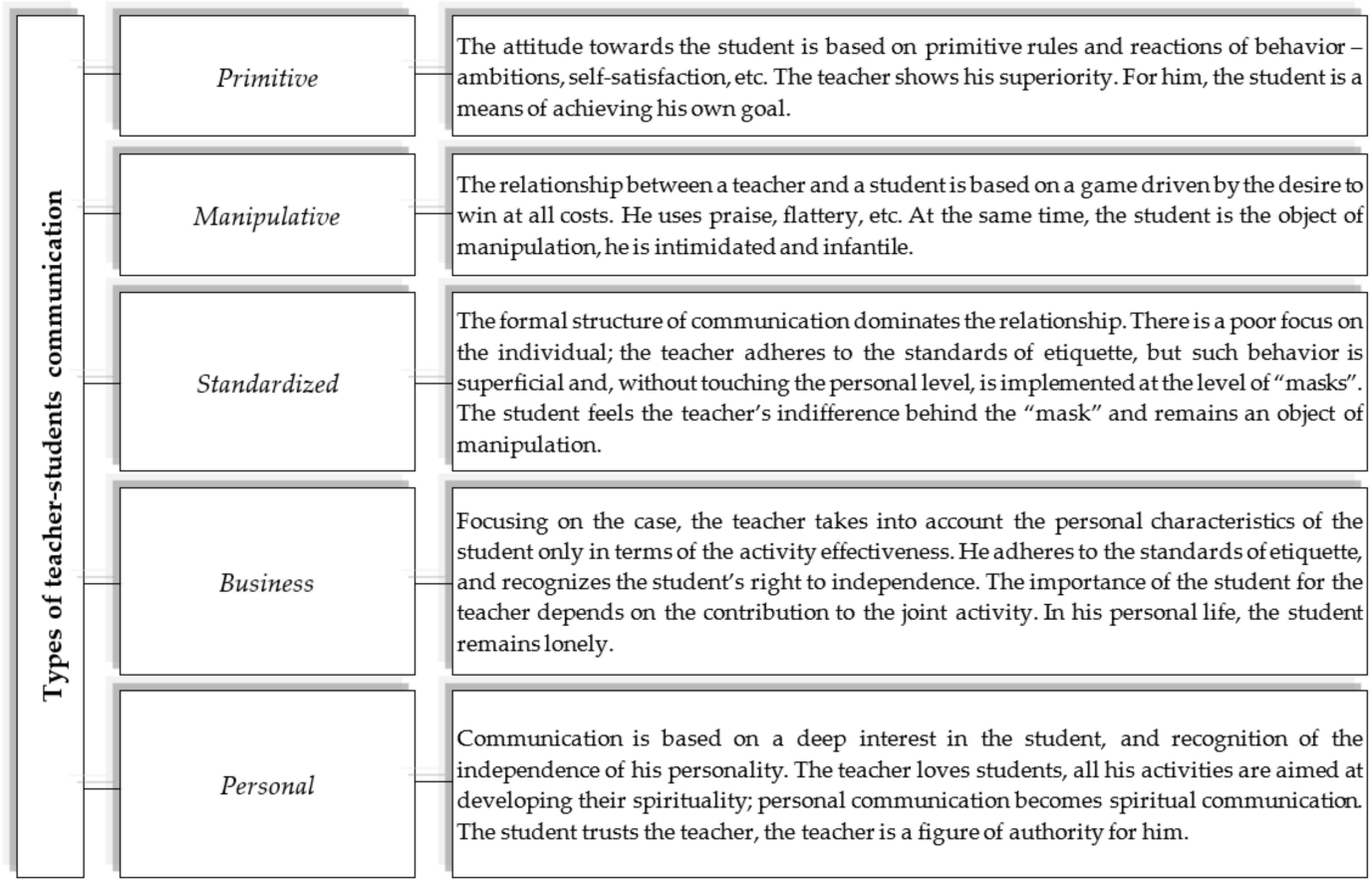

Figure 1. The main types of teacher–student communication [4].

As the figure indicates, among the above five types of communication between the teacher and the students, only the personal one has no flaws, it seems to combine professional and personal components harmoniously. However, there is such a concept as the teacher–student communication style, which, according to the classical classification, is divided into authoritarian, democratic, and liberal.

The authoritarian style is characterized by dictation, which turns students into passive performers. An authoritarian teacher independently determines the direction of the group's activities. The democratic style is based on deep respect, trust, and orientation to self-organization, and self-management of the individual and the team, designed to convey the purpose of the activity to the consciousness of every student and involve everyone in active participation in a joint cause. Under the liberal style, the teacher does not have a stable pedagogical position, it is manifested in non-interference, and a low level of requirements for education. Such a teacher is limited to performing only the teaching function.

Having analyzed the specified styles of teacher–student communication, we conclude that in their pure form none of them is perfect, each of them has certain shortcomings: an authoritarian style inhibits initiative, and depresses students; the consequence of the liberal style is a loss of respect and deterioration of academic performance and discipline;

and the democratic style can be effective only when students take the educational process consciously, which is not characteristic of all students.

Based on different types and styles of teacher–students communication, certain psychological and behavioral types of teachers as educators can be identified (Figure 2).

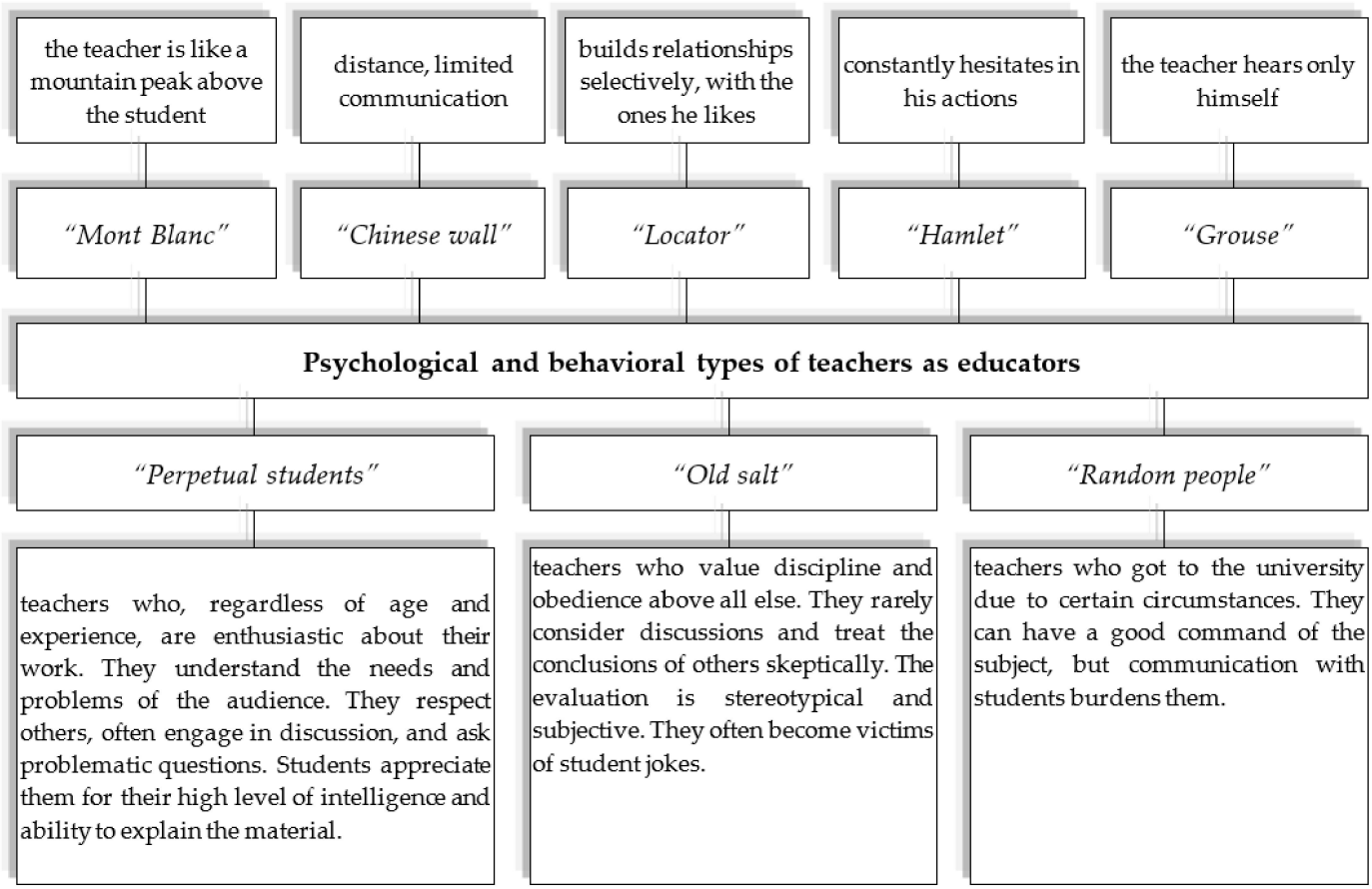

Figure 2. Psychological and behavioral types of teachers as educators [5,6].

There are also other classifications of the styles of educators' activity; "theorists", "realists", "utilitarians", and "intuitives". The basis of this classification is the attitude towards the fulfillment of one's duties and the peculiarities of the educator's character (V.Yahunov) [7]. Other classifications are formed according to the level of professional ethics and features of activity; "intellectual", "willful", "emotional", and "organizational" [8]. Analyzing the educator's behavior in combination with their pedagogical activity and its results, A. Boyko singles out well-founded models of relationships between teachers and students as follows: "optimist", "objectivist", "erudite", "talent", "craftsman", "soul", "actor" [9].

Along with the styles, we can distinguish forms of teacher–student communication:

- communication based on enthusiasm for joint creative activity—active and positive attitude towards students, love for work, mutual understanding;
- communication based on a friendly attitude—students' positive perception of a teacher who shows kindness and respect to students;
- distance communication—a form of communication, in which teachers and students are limited to formal relationships;
- communication/intimidation combines a negative attitude towards students and authority in the organization of activities;
- flirting communication—a form of communication, in which a positive attitude towards students is combined with liberalism, i.e., the teacher seeks to gain authority,

wants to be liked by students, but does not try to find appropriate ways of organizing interaction.

The studied communication styles have certain disadvantages. Summarizing them, it is worth noting that a certain distance between the teacher and students is still necessary, but it cannot be the main criterion in the relationship, and the key to a productive form of teacher communication is a focus on students, passion for work, and delicacy in relationships.

Having analyzed the styles and types of communication between the teacher and students, having distinguished their positive and negative sides, as well as taking into account their experience of working with young people, we conclude that the formation of a sense of professional unity between the teacher and students contributes to the improvement of the quality of the educational process. This issue will be discussed in Section 4.1.

3. Methodology

The research methodology was a survey conducted by the CAWI method using a structured questionnaire based on the respondents' place of permanent residence. The sample totality was stratified according to the regions of Ukraine where the teachers work. Teachers of Ukrainian higher education institutions took part in the study. The study sample included 350 people. The main tasks of the study were to analyze the potential of university teachers in the pre- and post-war periods, to find out the attitude of teachers to the war and the possibility of their professional activities under the conditions of the war, as well as to learn about their views on the post-war period.

To achieve the goal of the research, special attention was paid to the profession of the respondents (a university teacher), while personal data (surname and first name, name of the university, position, etc.) were not important. That is, the survey was conducted among university teachers, without taking into account the realm and specificity of their research and work.

Before starting the survey, the respondents were warned about the objectives of the study and that these materials would be processed and subsequently published in a scientific journal.

Participation in the survey was based upon voluntary consent to the use of the obtained results, of which the respondents were informed.

Computer assisted web interview (CAWI)— was used to collect answers to questions on a special server after reading them independently. A letter was sent to the e-mail address of the registered user (in the online panel/in the respondent database) with an offer to participate in the survey. By following the link, the respondent was redirected to the server to participate in the survey.

The list of questions in the questionnaire and the answers of the respondents are presented in the next section.

4. Results

4.1. Formation of a Sense of Professional Unity as a Guarantee of High-Quality Knowledge

For a deeper understanding of this concept, let us turn to the interpretation of the concept of "unity". This is a moral, philosophical, and social principle, the fundamental provisions of which are the responsibility of all for all, the accord of the individual and the collective, and mutual spiritual enrichment and development. That is, the professional unity of students and teachers implies cooperation, mutual responsibility, a common goal, and mutual development. Simply put, the teacher and the student must share a common goal, equality in the relationship, as well as have a relationship, in which the teacher teaches the students while learning from them.

To form a sense of professional unity between the teacher and students, the teacher must, first of all, get rid of authoritarian forms of pedagogical influence, in pedagogical communication and focus on a mature personality with developed self-awareness. At the same time, the teacher should use the professional interest of students as a factor influencing education and training and, based on that, implement pedagogical communication and the

entire system of educational work. Teachers are also entrusted with the role of curator of academic groups, the teacher's performance of which fulfills their educational function. Teachers should create conditions for increasing the social and political activity of students through their involvement in joint forms of work with the teacher, from time to time, implementing informal and unregulated contacts between teachers and students.

In this regard, to form a sense of professional unity, teachers, as well as group curators should participate in student leisure, attend cultural and mass events, conduct joint leisure, carry out educational work in dormitories, etc. From the perspective of educational and scientific activity, teachers should involve students in various forms of research activity.

Professional unity implies that the student fulfills the role of not only the object but also necessarily the subject of the educational process. That is, the student himself should feel like an active participant in the educational process. and use the acquired knowledge as a means for self-improvement. Such a role of an object-subject-student requires real skill from the teacher to direct educational and cognitive activity in the right direction.

Communication between a teacher and a student is specific because they are in different positions by status: the teacher organizes the interaction, and the student perceives it and is included in it. The teacher's task is to help the student become an active participant in the pedagogical process, to provide conditions for the realization of his potential opportunities, that is, to guarantee a sense of professional harmony between the students and the teacher.

Taking into account the peculiarities of the pedagogical activity of a university teacher and having analyzed the theoretical foundations of the pedagogical activity, in particular the types and styles of communication between a teacher and students, we believe that the key to the high quality of the educational process in a higher educational institution is the formation of a sense of professional unity among students and teachers. That is, there should be a certain unity between the teacher and the student, a common goal, equality in relations; the teacher should learn from students while teaching them. To improve the quality of the educational process, the student themselves must feel like active participants in the educational process [6].

Today, an important issue in the development of education is also the development of tools that would act as cross-sectional, integrating factors in the structuring of the education system in various types of professional activity. In our opinion, reflection can be such a tool in the pedagogical activity in higher education.

4.2. Reflection as the Basis of Students' Professional Skills

The educational process in a higher education institution requires students' reflection, i.e., searching, evaluating, and discussing their learning experiences with themselves. Learning occurs thanks to guided reflection, due to which different ways of solving tasks arise. A high level of development of reflection enables students to realize what they have already learned; evaluate their level of understanding of the educational material, make up a plan for the further implementation of this plan in practical life and labor activity; conduct a comparative analysis of their perception with the thoughts, feelings, views of peers and correct certain aspects if necessary. This must be done to realize their actions and predict further steps of educational activity.

For the process of reflection to be regularly used in the educational process of students the ability to reflect on needs should be purposefully formed. The teacher's task is to help students develop a need for knowledge reflection and feedback, as well as the need to analyze their activities, the results of their activities, and the activities of other group members.

In educational activity, reflection is the process of student's assimilation of educational material employing its comprehension, analysis, generalization, matching with their own experience and knowledge through intellectual abilities, erudition, and critical thinking. That is, a more erudite and intelligent student, or the one experienced in the subject being studied, is more able to reflect. This means that the level of assimilation of the material will

be higher, and it will increase their professional skills in the future. That is, reflection is the basis of a student's professional skills.

Obstacles to the development of reflection are objective (lack of motivation, lack of self-interest, inadequate self-esteem, insufficient formation of the processes of analysis, evaluation, etc.) and subjective (self-doubt).

D. Nicol and D. Macfarlane-Dick point out that the main goal of reflection in learning activities is to help students develop as independent individuals able to control and regulate their learning. Students must self-assess and regulate their learning. Reflection helps students take responsibility for setting their learning goals and evaluating progress toward achieving these goals [10].

R. Alrubail notes that reflection is a powerful tool in educational activities, as it allows students to distinguish such components of learning as significance (allows students to see the importance of their learning process); recognition of the process (students can determine what they did well, what they failed to achieve, what needs to be changed); solutions/strategies (provides students with opportunities to decide on further strategies to improve the educational process); motivation (reflection gives students motivation to learn and enjoy the learning process); and analysis (the most important advantage of reflection is that students can find out why they should study concepts, theories, and presented material). The researcher notes that critical thinking comes from reflecting on knowledge, on "how" and "why" the student is learning it at the moment. R. Alrubail singles out four levels of reflection based on its development in the time interval during learning—a student before the learning, a student during the learning, a student after the learning, and a student moving forward [11] (Figure 3).

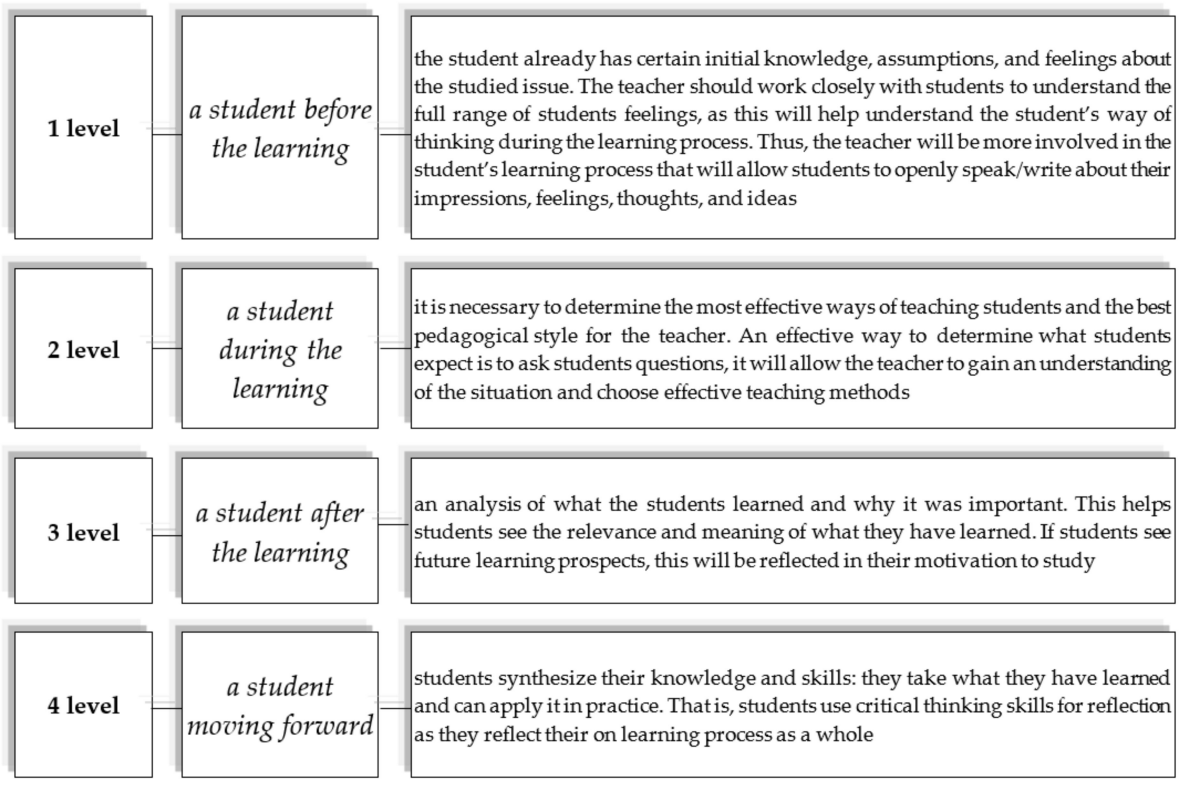

Figure 3. Levels of reflection depending on its development over time during training [11].

The following signs of developed reflection of students should be distinguished: understanding of the content, subject, purpose of educational activity, critical thinking, striving for self-knowledge and understanding of other subjects of educational activity, self-observation, self-control, self-regulation, ability to forecast future actions, set goals, ability to analyze their educational activity, etc.

According to Bloom's observations, learning is a process of gaining experience through the application of reflection. Reflective experience is the creation of one's own questions about the issue under study and active and conscious control over its understanding. Bloom also proposed the following classification of students' reflection [12] (Figure 4).

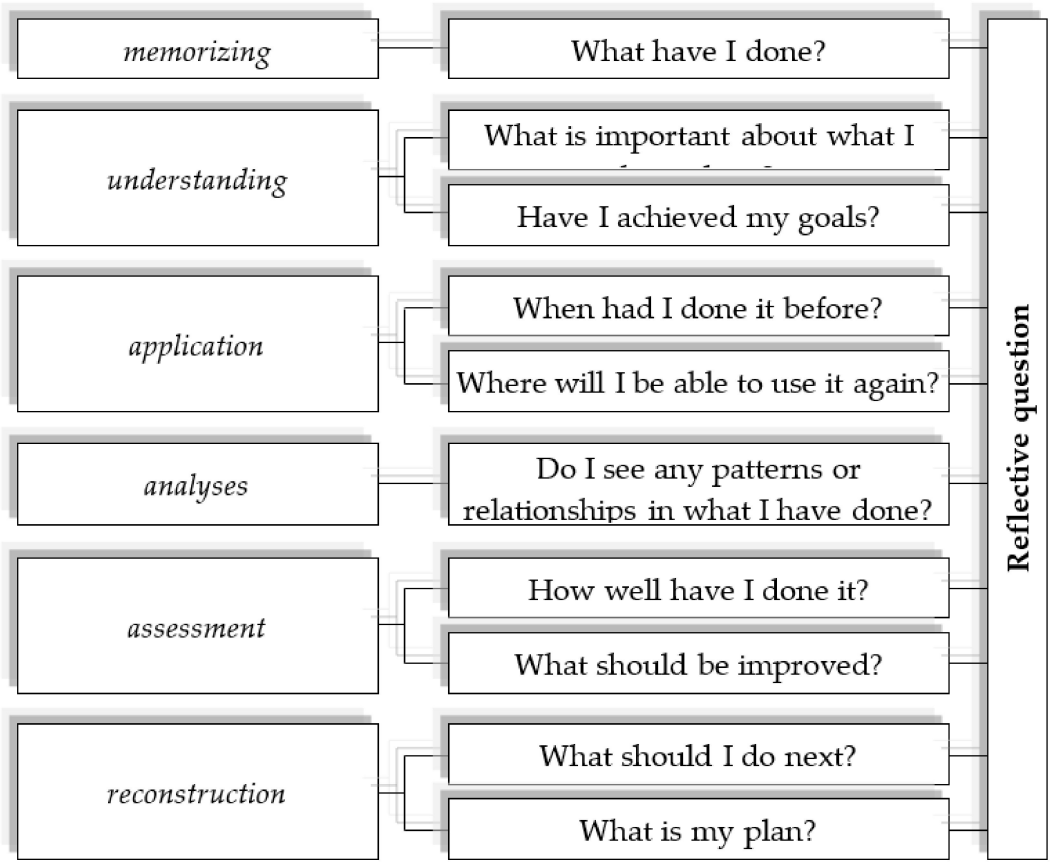

Figure 4. Bloom's classification of students' reflection.

Reflection is an important component of the modern educational process, as well as a systemic factor of continuous education. Students should be familiar with the flow of information, able to supplement their knowledge independently and show a creative approach to solving educational tasks. Today, the most important problem in the development of education is the development of tools that are cross-sectional, integrating factors in the structuring of the education system in various types of professional activity. In our opinion, reflection can be such a tool in pedagogical activity in the field of higher education [13].

The development of the students' thinking process must be studied from the standpoint of their theoretical thinking capabilities, a key component of which is the reflection that determines the student's understanding of their actions and their compliance with the conditions of the assignment. The phenomenon of reflection presupposes that the subject directs cognition to himself, that is, the subject becomes an object of cognition for himself.

The leading idea of the educational process in higher educational institutions is to develop an intelligent personality capable of self-reflection through the systematic organization of educational activities. The student takes responsibility for learning, takes an active position, and the teacher takes the role of an expert or assistant. They understand the goals of training, the final results, and that the primary goal of this activity is awareness and a thorough, deep assimilation of information, with the possibility of applying it in the future, and not a plain memorization of the material. The educational activity of students is aimed at mastering professional knowledge and ways of working in the course of solving educational tasks, which involves such a component as reflection [1].

4.3. Professional Pedagogical Activity of a University Teacher as One of the Important Components of the Sustainable Development of Society

Education is an important component necessary for building a prosperous state. It is the teachers who must be professionals in their field and contribute as much as possible to the student's formation of the necessary knowledge and skills that will allow them to raise worthy members of society. Therefore, to be a teacher, it is necessary not only to know your subject perfectly but also to have considerable knowledge and skills as a psychologist, diplomat, manager, etc., as well as to constantly work and improve your image of a "progressive teacher".

The war, which has split the lives of Ukrainians into "before" and "after", only proves the fact that a university teacher should be much closer to students. He should be interested not only in their educational process but also communicate and help psychologically, being close to them.

The awareness that the war in Ukraine erases entire villages and cities from the map of Ukraine, and destroys civil infrastructure, educational, cultural, and sports institutions only increases the depressed state of the young generation. As of 7 June 2022, according to the Office of the General Prosecutor of Ukraine, as a result of the war, 1958 educational institutions have been damaged due to the constant bombing and shelling of Ukrainian cities and villages. At the same time, 186 of these have been utterly destroyed. For example, all buildings of one of the best universities in Ukraine named after Karazin (Kharkiv) have been utterly destroyed. Every day, Kharkiv, the city where several dozen of the best universities and research institutes in Ukraine are located, suffers from the bombings. Students and teachers have died during the shelling of the civilian population [14]. The hope of returning to their home, to their educational institution is fading day by day.

Nevertheless, teachers should continue working, improving themselves and, for their students, be an example of courage and faith in a bright future. A teacher must be a leader, an inspirer, and a motivator, a person who is ready to depart from stereotypes and strive to be the first for others to follow.

In wartime, teachers face certain challenges, such as teaching in stressful situations, a decrease in students' activity, students' dissatisfaction with online learning, a lack of opportunity to study online and with constant access to the internet, the peculiarities of wartime forecasting, etc.

One of the tasks facing university teachers should also be to teach and communicate with students who have certain disabilities and do not have the opportunity to communicate with their peers and receive a comprehensive education at the university. This is especially relevant in the post-war period [15].

Currently, the educational process takes place remotely in online mode. The COVID-19 emergency initiated such a format of work for all universities across the world, and therefore, in the last two years, teachers have had the opportunity to prepare [16]. Thus, we agree with the opinion of the researchers who emphasize that students often view online communication as a comfortable and safe environment for self-expression and learning [17].

Recently, there have been a number of publications on the implementation of sustainable development policy in the development of study programs and increasing the attention of teachers to the practical implementation of a healthy lifestyle and improving the ecological state of the natural environment [18].

Moreover, in the era of intensive development of digital technologies, teachers should be able to develop new learning situations, relying on the growing supply of available digital resources, which will ensure a balance between economic growth, respect for the environment and social justice. It is important to understand one's actions, have the necessary knowledge, and be ready and strive to act, that is, to have certain competencies. Thus, the researchers proposed several indicators that serve to characterize four dimensions of scientific competence: the content of science, the content about science, the value of science, and the usefulness of science in educational materials [19].

Lynda Dunlop and Elizabeth A. C. Rushton, investigating the issue of the influence of the state of the natural environment, ecology, and climate change on the emotional state of a person, prove that it is the teachers who must take responsibility and convey to students the correct information about the importance and necessity of sustainable development policy [20]. According to research, optimism and a good mood of a person are somewhat related to faith in a bright future. And according to experts' estimates, 50% of people "lean towards sustainable development, but are disappointed". For this category of people, a positive social and ecological future is, of course, of the highest value [21].

In their works, scientists prove that education for sustainable development can help achieve its goals, explain each goal of sustainable development, and emphasize the need to study them in the educational process [22,23]. Thus, education for sustainable development should not only equip students with the knowledge but also promote and develop the acquisition of sustainable development competencies to address the challenges of the 21st century at the social, environmental, and economic levels [24]. Therefore, in the teaching profession, it is important to competently explain and correctly interpret the essence of the processes taking place in society and the world.

To implement education for sustainable development, teaching approaches must focus on the elements related to the learning process rather than the accumulation of knowledge to develop in graduates the capacity for improvisation, adaptation, innovation, and creativity. That is why scientists justify the need to apply critical thinking, which in their opinion is an important element of education related to sustainability [25].

A necessary circumstance for the educational process of students, and in particular the study of the basics of sustainable development, is the use of reflective pedagogy in leadership training, which will clearly define the structure for directing student reflection to the development of individual skills and the use of collective reflection to encourage generative dialogue between students and teachers [26,27].

An important component of the educational process is the choice of the correct method of assessing students' knowledge. We follow the researchers who believe that modern methods of student evaluation should be more democratic to turn the mainly institutional goals of evaluation into an educational experience that can develop students' competence in evaluation [28–30].

4.4. The Potential of University Teachers in the Pre-War Period

As of 1 October 2021, 996 institutions were represented in the Register of Subjects of Educational Activity as "Institutions of Higher Education" of the Unified State Electronic Database on Education (EDEBO). Of these, 831 belong to the "Institution of Higher Education" category, and 165 to the "Research institutes (institutions)" category. The first category contains the following subgroups:

- universities, academies, institutes—450 institutions;
- colleges, technical schools, schools—493 institutions;
- separate subdivisions—140 institutions;
- other scientific institutions (organizations)—1 institution.

The regional distribution shows the concentration of the majority of higher education institutions in the city of Kyiv, as well as in the Dnipropetrovsk, Lviv, Odesa, and Kharkiv regions (Figure 5).

As already noted, this group consists of 450 higher education institutions. More than half of these are state institutions (257), more than a third are private (167), and 26 are communal. The regional distribution of this group of higher education institutions is similar to the distribution of higher education institutions in general: the city of Kyiv, Dnipropetrovsk, Lviv, Odesa, and Kharkiv regions are also the leaders. A more detailed analysis shows five cities that are distinct "university hubs": Kyiv, Kharkiv, Lviv, Odesa, and Dnipro.

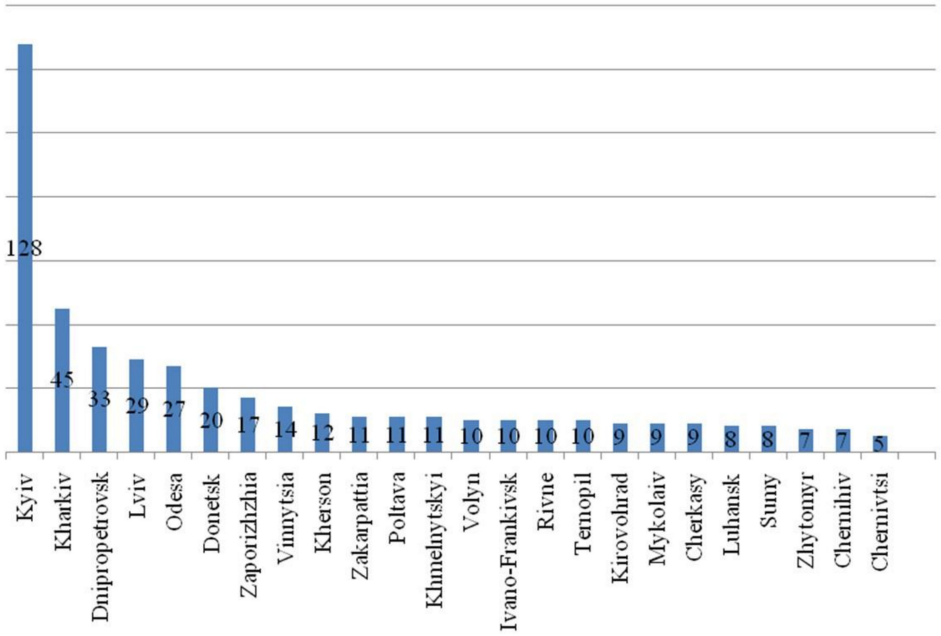

Figure 5. Regional distribution of higher education institutions at the university level. Source: compiled based on data from the State Statistics Service of Ukraine.

According to the EDEBO database as of 1 October 2021, there were 1,028,350 higher education students in Ukraine with the degrees of "Junior Bachelor", "Bachelor", "Specialist" and "Master". Compared with 1 October 2020, this number decreased by 3.45% (by 36,793 people).

According to the EDEBO database as of 1 October 2021, the distribution of students by the level of higher education is as follows: 3631 persons obtained the "Junior Bachelor" degree, "Bachelor"—718,633 persons, "Specialist"—2750 persons, "Master"—303,336 people.

According to the State Statistics Service of Ukraine, at the beginning of the 2020/2021 academic year, the teaching staff of universities, academies, and institutes was 135,216 people, of which 111,065 were academic staff, 566 were researchers, and 23,585 were teaching staff. 77,380 university teachers (57.2% of their total number) have a scientific degree, in particular, 16,791 people (12.4%) have a Doctor of Science degree, 59,975 people have a candidate of science (comparable to the scientific degree of Doctor of Philosophy) (44.4%), and 614 persons have a Doctor of Philosophy degree—(0.5%) (Table 1).

Table 1. Number of higher education teachers with a scientific degree (as of the beginning of the 2020/2021 academic year).

Scientific Degree	Academic Staff	Researchers	Teaching Staff	Total
PhD	595	2	17	614
Candidate of science	56,949	267	2759	59,975
Doctor of science	16,131	105	555	16,791
Total	73,675	374	3331	77,380

Source: compiled based on data from the State Statistics Service of Ukraine.

Of the total number of university teachers, 55,295 (40.9% of total number) have an academic title, including the title of professor—12,870 (9.5%), associate professor—41,171 (30.4%), senior researcher—1254 (0.9%) (Table 2).

Table 2. The number of teachers of higher education institutions with academic titles (as of the beginning of the 2020/2021 academic year).

Academic Title	Academic Staff	Researchers	Teaching Staff	Total
Professor	12 403	68	399	12,870
Associate Professor	39,548	136	1487	41,171
Senior researcher (senior research associate)	1159	36	59	1254
Total	53,110	240	1945	55,295

Source: compiled based on data from the State Statistics Service of Ukraine.

The gender balance of domestic university staff is slightly shifted in favor of women, whose ratio is 60.4%. However, the situation also differs by individual categories of teachers: the largest number of women is among teaching staff (69.8%), somewhat less is among academic staff (58.4%) and the least is among researchers (51.9%).

However, with the beginning of the war, there were significant changes in the education system of Ukraine. This issue is discussed in the next section of the study.

4.5. Consequences of a Full-Scale War for Higher Education in Ukraine

In Ukraine, since the beginning of the war, 158 children have died, and 258 have been injured. These data are incomplete, as it is currently impossible to obtain accurate information from the occupied territories. The most children were affected in the Kyiv region—75, Donetsk—71, Kharkiv—56, Chernihiv—46, Mykolaiv—31, Luhansk—31, Zaporizhzhia—22, Kherson—29, Sumy—16, Zhytomyr—15.

The Ministry of Education and Science set up a special site with an interactive map of the destruction, but the extent of the damage is increasing faster than the moderators can update the information on the site. However, even these incomplete statistics show that the educational infrastructure of the Kharkiv region, which is at the epicenter of hostilities, suffered almost the most in Ukraine. At the same time, the destruction of universities, in particular, is a double blow to the education system and the scientific potential of the state, and therefore a double blow to the economy, which is extremely difficult to assess.

In total, since the beginning of the war, 2104 educational institutions have been bombed, 215 of them were completely destroyed. The worst situation is in Kharkiv—504 institutions, 452 of which were damaged and 52 utterly destroyed, Donetsk—481 institutions (400 damaged and 1 utterly destroyed), Kyiv—246 institutions (234 damaged and 12 utterly destroyed), Mykolaiv—190 institutions (174 damaged and 16 utterly destroyed), Luhansk—159 institutions (142 damaged and 17 utterly destroyed), and Chernihiv oblast—133 (121 damaged and 12 utterly destroyed). Educational institutions of the Volyn, Zakarpattia, Ivano-Frankivsk, Ternopil, Khmelnytskyi, and Chernivtsi regions were not damaged (Table 3) [31].

According to the latest UN data, there are almost five million Ukrainian refugees in Europe. More than half of them received temporary protection or a similar status in European countries. Tens of thousands of Ukrainians either have already arrived or received permission to stay in the USA and Canada.

More than a hundred days of the war in Ukraine have resulted in tens of thousands of deaths and injuries, destruction of infrastructure and buildings, and forced millions of Ukrainians to leave their homes in search of safety. According to UNICEF, 5.2 million children from Ukraine need humanitarian assistance, and 2.2 million of these are in countries that host Ukrainian refugees. According to the organization's statistics, two out of three children in Ukraine have been displaced as a result of hostilities. It is children and women who make up the vast majority of Ukrainians seeking refuge from war abroad.

Table 3. Information on the destruction caused to Ukrainian educational institutions as a result of Russia's attack on Ukraine.

№	Regions	Destroyed						Damaged						Total in the Region
		Kindergartens	Schools	Vocational Educational Institutions	Higher Educational Institutions	Institutions of Extracurricular Education	Total	Kindergartens	Schools	Vocational Educational Institutions	Higher Educational Institutions	Institutions of Extracurricular Education	Total	
1	Kharkiv	3	43	2	1	3	52	173	185	55	19	20	452	504
2	Donetsk	-	-	-	-	1	1	209	221	44	6	0	480	481
3	Kyiv	6	4	2	-	-	12	82	134	14	0	4	234	246
4	Mykolaiv	8	8	-	-	-	16	59	91	17	3	4	174	190
5	Luhansk	4	6	6	-	1	17	46	73	16	2	5	142	159
6	Chernihiv	5	6	1	-	-	12	46	60	11	3	1	121	133
7	Zaporizhzhia	24	45	9	4	1	83	1	4	3	3	-	11	94
8	Kherson	4	7	1	-	-	12	20	38	8	1	3	70	82
9	Zhytomyr	-	1	-	-	-	1	24	38	9	2	3	76	77
10	Sumy	1	-	-	-	-	1	11	17	11	1	5	45	46
11	Dnipropetrovsk	-	-	-	-	-	-	7	12	8	-	-	28	28
12	Vinnytsa	-	-	-	-	-	-	8	4	4	1	-	17	17
13	Odesa	-	-	-	-	-	-	2	7	2	-	3	14	14
14	Cherkasy	-	-	-	-	-	-	6	5	3	-	-	14	14
15	Poltava	-	-	-	-	-	-	4	2	4	-	-	10	10
16	Kirovograd	-	-	-	-	-	-	2	2	1	-	-	5	5
17	Rivne	-	-	-	-	-	-	-	2	-	-	-	2	2
18	Lviv	-	-	-	-	-	-	-	-	-	1	-	1	1
19	Volyn	-	-	-	-	-	-	-	-	-	-	-	-	0
20	Zakarpattia	-	-	-	-	-	-	-	-	-	-	-	-	0
21	Ivano-Frankivsk	-	-	-	-	-	-	-	-	-	-	-	-	0
22	Ternopil	-	-	-	-	-	-	-	-	-	-	-	-	0
23	Khmelnytskyi	1	-	-	-	-	-	-	-	-	-	-	-	0
24	Chernivtsi	-	-	-	-	-	-	-	-	-	-	-	-	0
	Total in Ukraine	56	120	21	5	6	207	700	895	210	42	48	1896	2104

According to the statistics of the Office of the United Nations High Commissioner for Refugees, as of June, there are about 4.9 million refugees from Ukraine in 44 European countries. Of these, 3.2 million Ukrainians received temporary protection or similar status in refugee-hosting countries.

According to UN statistics, the majority of Ukrainian refugees are in neighboring Poland. Statistics for all neighboring countries are as follows [31]:

- Poland—1 million 152,000;
- Russia—1 million 116,000 (UNHCR includes data officially submitted by the Russian Federation and cannot verify reports of forced deportations, the UN General Assembly explained);
- Moldova—86,000;

- Romania—82,000 (34,000—under the temporary protection program);
- Slovakia—77,000;
- Hungary—24,000;
- Belarus—8000.

In the case of Poland, Slovakia, and Hungary, the statistics reflect the number of Ukrainians who received the national equivalent of special protected status in these countries. There are no statistics on the number of Ukrainians under temporary protection programs in Russia, Moldova, and Belarus. Among all European countries, Germany is the third largest host country for Ukrainian refugees, where 780,000 Ukrainians are hiding from the war, almost 566,000 of whom have received a special protected status. Other large European countries receiving Ukrainian refugees are the Czech Republic, Italy, and Spain.

4.6. Survey Results

The questions of the questionnaire were constructed in such a way that only the profession of the respondents was important since the purpose of the study is the university teachers' potential in the pre- and post-war periods, their attitude to the war, the possibility of carrying out their professional activities under the conditions of the war, their views on the post-war period, etc.

To the question "Your location after the start of the war on 24 February 2022." the respondents gave the following answers: 62% of respondents remained at their primary places of residence, 32% left for other regions and received the status of internally displaced persons, 6% left abroad. Persons who traveled abroad (21 persons or 6% of all respondents) were asked an additional question "In which country are you currently located? This was an open question, the respondents indicated mainly European Union countries, Great Britain, and Canada. Another question asked to persons who went abroad was "What do you do abroad?". Of the respondents, 52% answered, "I work online at the main place of work in Ukraine", 27% are undergoing internships at foreign universities or have found a part-time job there, and the remaining 21% chose the option "Other".

The main questions, answer options, and survey results both in quantitative and percentage form are presented in Table 4.

Table 4. The main questions and teachers' answers to the survey.

№ з/п	Question	Answer Options	Results	
			Quantity	%
1	Your location after the start of the war on 24 Ferbruary 2022	stayed at their primary place of residence	217	62
		moved to other regions and received the status of internally displaced persons	112	32
		Moved abroad	21	6
2	What country are you currently in?	your answer:	E U countries, Great Britain and Canada	
3	What are you doing abroad?	I am working online at my primary place of employment in Ukraine	11	52
		I am undergoing internships at foreign universities or am employed part-time in them	6	27
		other	4	21
4	Do you feel safe?	yes	59	17
		no	291	83

Table 4. *Cont.*

№ з/п	Question	Answer Options	Results	
			Quantity	%
5	Can you perform your professional duties at a pre-war level?	yes	77	22
		no	273	78
6	How do you engage in war?	service in the Armed Forces of Ukraine	18	5
		volunteering	45	13
		direct assistance to the community of your university	73	21
		I don't help in any way	66	19
		other	148	42
7	Do you think it is possible to fully implement the study programs of your academic courses and the planned scientific workload in the current situation?	yes	84	24
		no	266	76
8	What problems prevent you from fulfilling your professional duties to the fullest extent?	Other answers:	Being detached from the access to the material and technical base of universities, communication problems between teachers and students due to the lack of communication and the Internet	
9	Did the war affect your professional activity in terms of objectivity in assessing student performance?	yes, when assessing the success of students during the military operations, along with objective evaluation criteria, there were subjective evaluation criteria—compassion, leniency, etc., which were caused by a difficult life situation under wartime conditions	287	82
		no, when assessing the success of students during the period of military operations, I objectively evaluate the knowledge and skills of students	63	18
10	Were you interested in the position of the students regarding Ukraine's relations with the Russian Federation before the war?	yes	42	12
		no	308	88
11	Are you interested in the position of students regarding Ukraine's relations with the Russian Federation after the start of the war?	yes	266	76
		no	84	24
12	Please list what, in your opinion, are the main threats of the war to higher education in Ukraine	your answer:	reduction of academic staff due to underfunding of universities; destruction and damage to the material and technical base; loss of students and entrants due to young people's departure abroad, etc	

Table 4. *Cont.*

№ з/п	Question	Answer Options	Results	
			Quantity	%
13	In your opinion, the main threats of the war to higher education in Ukraine are:	reduction of academic staff due to underfunding of universities	200	57
		the destruction and damage of the material and technical base	77	22
		loss of students and entrants due to the departure of young people abroad	42	12
		other reasons	31	9
14	In your opinion, the key factors in the development of teachers' potential in the post-war period may be	other answers	raising morale and patriotism; investment in education; international cooperation; rethinking educational policy	

The next block of questions related to adaptation to new conditions because of the displacement caused by the war. Thus, from this sample to the question "Do you feel safe?" only 17% answered "Yes". Other teachers, 83%, answered "No", that is, even in the regions of Ukraine where active hostilities are not taking place, they feel in danger and, according to their estimates, are unable to concentrate on the performance of their professional duties at the pre-war level.

To the question "Can you perform your professional duties at the pre-war level?" only 22% answered "Yes", and the rest 78% answered "No". Another question regarding the new teaching conditions that have occurred "Do you think it is possible to fully implement the teaching programs of your academic courses and the planned scientific workload in the current situation?" received the following answers: 76% answered "No", 24% answered "Yes". That is, the absolute majority of teachers consider it impossible to fully implement the study programs of their academic courses and the planned scientific workload under the conditions caused by the war.

Next, the respondents were asked to answer the open question "What problems prevent you from fulfilling your professional duties in full?". The respondents cited the following problems: detachment from the material and technical base of universities, communication problems between teachers and students due to the lack of communication opportunities and the internet, etc.

Investigating the personal potential of teachers, in particular its psychological component, the question "How do you engage in war?" was asked. The answer option "service in the Armed Forces of Ukraine" was chosen by 5% of respondents, "volunteering"—13%, "direct help to the community of the university"—21%, "I do not help at all"—19%, "other"—42%. Thus, as a result of the survey, it was established that at least 39% of respondents have an active position (service in the Armed Forces of Ukraine, volunteering, and direct assistance to the community of their university).

The next question was "Did the war affect your professional activity in terms of objectivity in assessing student performance?" to which the vast majority of 82% of the surveyed teachers answered "Yes, when assessing the success of students during the military operations, along with objective evaluation criteria, there were subjective evaluation criteria—compassion, leniency, etc., which were caused by a difficult life situation under wartime conditions", and only 18% remained objective and chose the answer "No, when assessing the success of students during military operations, I objectively evaluate the knowledge and skills of students".

Another question regarding the interaction of teachers with students was the following: "Were you interested in the position of the students regarding Ukraine's relations with the Russian Federation before the war?". Of the respondents, 12% answered "Yes" and 88% answered "No". To compare the relationship between teachers and students in the pre- and

post-war periods, the following question was asked: "Are you interested in the position of students regarding Ukraine's relations with the Russian Federation after the start of the war?". Of the respondents, 76% answered "Yes", and 24% answered "No". That is, an increase in the level of teachers' interest in the position of students regarding Ukraine's relations with the Russian Federation has been established. If before the war in 2022, 12% of the surveyed teachers were interested in the students' position, then after the full-scale invasion, the number was 76%.

To establish the threats of the consequences of the war in the field of higher education in Ukraine, respondents were first asked to answer the open question "Please list what, in your opinion, are the main threats of the war to higher education in Ukraine". The interviewees gave their answers, the processing of allowed for the most common ones to be formulated as follows: reduction of academic staff due to underfunding of universities; destruction and damage to the material and technical base; loss of students and entrants due to young people's departure abroad, etc. The next stage was to vote for the most common answers to the following question: "In your opinion, the key factors in the development of teachers' potential in the post-war period may be". Of the respondents, 57% voted for the option of "Reduction of academic staff due to underfunding of universities", for the option of "Destruction and damage to the material and technical base"—22%, for the option of "Loss of students and entrants due to the departure of young people abroad"—12%, "Other reasons" was chosen by 9% of respondents. The last question "In your opinion, the key factors in the development of teachers' potential in the post-war period may be" had an open answer. According to the answers of the respondents, we can state that the key factors in the development of the potential of teachers in the post-war period are as follows: raising morale and patriotism; investment in education; international cooperation; rethinking educational policy.

5. Conclusions

As a result of the survey, in which 350 Ukrainian teachers took part, the following results were obtained. More than half of them stayed at their primary place of residence, a third left for other regions and received the status of internally displaced persons, and only 6% left abroad. As a result of adaptation to new conditions due to the war, only 17% of the surveyed feel safe. Other teachers, even in the regions of Ukraine where active hostilities are not taking place, feel in danger and, according to their estimates, are unable to concentrate on the performance of their professional duties at the pre-war level. Studying the personal potential of teachers, in particular its psychological component, the issue of their participation in the war was considered. As a result of the survey, 39% either serve in the Armed Forces of Ukraine or are engaged in volunteering and direct assistance to the community of their university.

In the survey, it was found that the main threats of the war to the higher education of Ukraine, according to the respondents, are the reduction of academic staff due to underfunding of universities—57%; destruction and damage to the material and technical base—22%; loss of students and entrants due to departure of young people abroad—12%; other reasons—9%.

Furthermore, according to the answers of the respondents, the key factors in the development of the teachers' potential in the post-war period will be as follows: raising morale and patriotism; investment in education; international cooperation; rethinking educational policy.

Having analyzed the problems of higher education in the pre-war period, and assessing the consequences of the war, which is still ongoing, a new image of a "progressive university teacher" was proposed. Such a teacher only knows his subject perfectly but also has considerable knowledge and skills as a psychologist, diplomat, manager, etc., as well as constantly works and improves his professional and personal potential. Moreover, based on the renewal of the university teachers' potential, the training of highly qualified specialists with a high level of moral qualities will be carried out among the university

graduates, who will be in demand in the labor market. This will contribute to the needs of the country's recovery and ensure the sustainable development of society in the post-war period. This research can complement and enhance the theoretical discussion and practical experience on sustainable development through higher education.

Renewal of the university teachers' potential in the post-war period will allow the improvement of the educational process in higher educational institutions to significantly increase the level of professional training of students and ensure the sustainable development of society. Such renewal of the university teachers' potential in terms of sustainable development in the post-war period will ensure a balance between economic growth, respect for the environment, and social justice.

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References

1. Levkina, R.; Levkin, A.; Ryasnyan'ka, A. Refleksiya yak osnova profesiynykh umin studentiv (Reflection as the basis of students' professional skills). *Novyi Kolehium* **2021**, *3*, S.38–S.43. Available online: http://nbuv.gov.ua/UJRN/NovKol_2021_3_8.pdf (accessed on 28 September 2022). (In Ukrainian) [CrossRef]
2. Levkin, A.; Levkina, R.; Ryasnyanska, A. The experience of student self-government in improving the quality of the educational process. *New Coll.* **2020**, *3*, 84–87. [CrossRef]
3. Levkina, R.; Levkin, A.; Ryasnyans'ka, A. Suchasna osvita u strukturi staloho rozvytku pidpryyemstv suchasnoho biznesu (Modern education in the structure of sustainable development of modern business enterprises). *Novyi Kolehium* **2018**, *1*, S.45–S.47. (In Ukrainian)
4. Kaidalova, L.G.; Lyutaieva, T.V. *Pedahohichna Kultura: Navch. Posibnyk (Pedagogical Culture: Textbook)*; NFaU: Kharkiv, Ukraine, 2013; 156p. (In Ukrainian)
5. Bulakh, I.S.; Dolynska, L.V. *Psykholohichni Aspekty Mizhosobystisnoyi Vzayemodiyi Vykladachiv i Studentiv: Navch.-Metod. Posibnyk (Psychological Aspects of Interpersonal Interaction between Teachers and Students: Teaching Manual)*; Drahomanov National Pedagogical University: Kyiv, Ukraine, 2002; p. 114. (In Ukrainian)
6. Levkina, R.; Levkin, A.; Ryasnyanska, A. Formuvannya Pochuttya Profesiynoyi Sobornosti Studentiv ta Vykladachiv yak Zaporuka Vysokoyi Yakosti Navchalno-Vykhovnoho Protsesu u VNZ (The Formation of a Sense of Professional Solidarity among Students and Teachers as a Guarantee of High Quality of the Educational Process in Universities). Novyi Kolehium. 2018. \ 4. S. 35–38. Available online: http://nbuv.gov.ua/UJRN/NovKol_2018_4_9 (accessed on 28 September 2022). (In Ukrainian)
7. Yahunov, V. Pedahohichna maysternist ta yiyi skladovi. *Uchytel* **2000**, *1*, 35–37. (In Ukrainian)
8. *Intehrovanyy Kurs Teoriyi ta Istoriyi Pedahohiky: Indyvidualni Tyutorski Zavdannya dlya Studentiv II–V Kursiv: Navch. posibnyk (Integrated Course of Theory and History of Pedagogy: Individual Tutoring Tasks for Students of II–V Years: Teaching Manual)*; avtor-ukladach A. M. Boiko.: Poltava, Ukraine, 2007. (In Ukrainian)
9. Darahan, O.V. *Teoretychni Osnovy Formuvannya Indyvidualnoho Stylyu Pedahohichnoyi Diyalnosti Vykladacha Vyshchoho Navchalnoho Zakladu (Theoretical Foundations of the Formation of the Individual Style of Pedagogical Activity of a Teacher of a Higher Educational Institution)*; NTU "KPI": Kharkiv, Ukraine, 2010; pp. 71–83. (In Ukrainian)
10. Nicol, D.; Macfarlane-Dick, D. Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Stud. High. Educ.* **2006**, *31*, 199–218. [CrossRef]
11. Alrubail, R. Scaffolding Student Reflections. Edutopia Community Facilitator. *Stud. Voice Lit. Writ. Proj.* **2016**, *12*, 34–47.
12. Bloom, D. A Taxonomy of Reflection: Critical Thinking for Students, Teachers, and Principals. *Am. J. Psychol.* **2010**, *93*, 17–36.
13. Carlton, L. *The Importance of Student Reflection*; Academic Press: Cambridge, MA, USA, 2013; Volume 18, pp. 25–34.

14. Ukraine's Mounting Death Toll Includes a Growing Number of Researchers. Science. Available online: https://www.science.org/content/article/ukraine-s-mounting-death-toll-includes-growing-number-researchers (accessed on 28 September 2022). [CrossRef]
15. Bagga-Gupta, S.; Dahlberg, G.M.; Winther, Y. Disabling and Enabling Technologies for Learning in Higher Education for All: Issues and Challenges for Whom? *Informatics* **2016**, *3*, 21. [CrossRef]
16. Daher, W.; Mokh, A.A.; Shayeb, S.; Jaber, R.; Saqer, K.; Dawood, I.; Bsharat, M.; Rabbaa, M. The Design of Tasks to Suit Distance Learning in Emergency Education. *Sustainability* **2022**, *14*, 1070. [CrossRef]
17. Martyushev, N.; Shutaleva, A.; Malushko, E.; Nikonova, Z.; Savchenko, I. Online Communication Tools in Teaching Foreign Languages for Education Sustainability. *Sustainability* **2021**, *13*, 11127. [CrossRef]
18. Fröberg, A.; Lundvall, S. Sustainable Development Perspectives in Physical Education Teacher Education Course Syllabi: An Analysis of Learning Outcomes. *Sustainability* **2022**, *14*, 5955. [CrossRef]
19. Napal, M.; Mendióroz-Lacambra, A.M.; Peñalva, A. Sustainability Teaching Tools in the Digital Age. *Sustainability* **2020**, *12*, 3366. [CrossRef]
20. Dunlop, L.; Rushton, E.A.C. Education for Environmental Sustainability and the Emotions: Implications for Educational Practice. *Sustainability* **2022**, *14*, 4441. [CrossRef]
21. Grund, J.; Brock, A. Why We Should Empty Pandora's Box to Create a Sustainable Future: Hope, Sustainability and Its Implications for Education. *Sustainability* **2019**, *11*, 893. [CrossRef]
22. Garcia, J.; da Silva, S.A.; Carvalho, A.S.; de Andrade Guerra, J.B.S.O. Education for Sustainable Development and Its Role in the Promotion of the Sustainable Development Goals. In *Curricula for Sustainability in Higher Education*; Davim, J., Ed.; Management and Industrial Engineering; Springer: Cham, Switzerland, 2017. [CrossRef]
23. Alam, G.M.; Roslan, S.; Al-Amin, A.Q.; Filho, W.L. Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'—Policy Framework to Respond COP21. *Sustainability* **2021**, *13*, 4520. [CrossRef]
24. Outcome indicator development: Defining education for sustainable development outcomes for the individual level and connecting them to the SDGs. *Glob. Environ. Chang.* **2022**, *74*, 102526. [CrossRef]
25. Thomas, I. Critical Thinking, Transformative Learning, Sustainable Education, and Problem-Based Learning in Universities. *J. Transform. Educ.* **2009**, *7*, 245–264. [CrossRef]
26. Ayers, J.; Bryant, J.; Missimer, M. The Use of Reflective Pedagogies in Sustainability Leadership Education—A Case Study. *Sustainability* **2020**, *12*, 6726. [CrossRef]
27. Botaccio, L.A.; Ortega, J.L.G.; Rincón, A.N.; Fuentes, A.R. Evaluation for Teachers and Students in Higher Education. *Sustainability* **2020**, *12*, 4078. [CrossRef]
28. Gryshova, I.; Koshkalda, I.; Demchuk, N.; Stebliuk, N.; Volosova, N. Strategic Imperatives of Managing the Sustainable Innovative Development of the Market of Educational Services in the Higher Education System. *Sustainability* **2019**, *11*, 7253. [CrossRef]
29. Gryshova, I.; Nikoliuk, E.; Shestakovska, T. Conceptualization of the organizational management mechanism of the development of the national education system in the context of its quality. *Sci. Educ.* **2017**, *10*, 118–125. [CrossRef]
30. Kazarian, G.; Gryshova, R.; Durglishvili, N. Regulatory Environment for the Formation of Leadership Positions for the Persons with Disabilities. In *Sustainable Leadership for Entrepreneurs and Academics*; Strielkowski, W., Ed.; Springer Proceedings in Business and Economics; Springer: Cham, Switzerland, 2019. [CrossRef]
31. Education under Threat. Interactive Map with Information on the Amount of Destruction Caused to Ukrainian Educational Institutions as a Result of Russia's Attack on Ukraine. *Ministry of Education and Science of Ukraine.* Available online: https://saveschools.in.ua/ (accessed on 28 September 2022).

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Service Quality of and User Satisfaction with Non-State-Owned Academic Libraries in China: Integrating the Fuzzy Delphi Method with the Kano Approach

Yi-Chang Chen [1,*], Chao-Chung Ho [2,*] and Shih-Ming Kuo [3,*]

[1] School of Finance and Accounting, Fuzhou University of International Studies and Trade, Fuzhou 350202, China
[2] Department of Banking and Finance, Tamkang University, New Taipei City 251301, Taiwan
[3] Department of Nursing, Fooyin University, Kaohsiung City 83102, Taiwan
* Correspondence: phdchen7219@gmail.com (Y.-C.C.); ho561598@gmail.com (C.-C.H.); sc012@fy.edu.tw (S.-M.K.)

Abstract: Libraries are digitizing, and challenges are posed by digital technologies for institutions of higher education in China. This study aims to present the dimensionality of perceived service quality, its effect on customer satisfaction, and the case of a non-state-owned library's academic service quality. A sample consisting of valid 453 respondents used online recruitment to retrieve answers to questionnaires. Ten experts were invited to review the questionnaire for content validity and question clarity. In this study, the Fuzzy Delphi method was used to establish questionnaire indices and the attributes of library academic service quality elements made available by the Kano model. Three dimensions, including emotional service, physical environment, and information control, which are correlated under the attribute classification of the Kano model, indicate support for the validity of using integrated models in measuring library service quality. The results, according to the improvements in the customer satisfaction matrix, provide nine elements to improve the quality of service and two major improvements to enhance the perception of service quality. In addition, users pay less attention to the use of academic resources and academic ethics, but these factors do not affect the quality of service.

Keywords: library service quality; non-state-owned library; fuzzy Delphi; Kano model;three-dimensional quality

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1. Introduction

Digital technology is widely used in academic libraries. It is worth mentioning that the rapid development of advanced technologies, which caused new pressures and barriers in service quality assessment, led to the challenges of sustainability, equality, and access and has played an important role in libraries. Recently, service quality has become an important issue for higher education due to digital technology regulation, online restrictions, and internet control in China. Assessing service quality is essential to users in the current competitive educational environment. In other words, the assessment of a library's success depends on the users' judgment of quality [1,2].

The library has a positive impact on the teaching, learning, and research of academic staff, and satisfactory library services can be quite helpful in instilling confidence in library users [3]. An important indicator of the quality assessment of higher education is the assessment of the quality of service. The quality of services provided to library users (primarily students and researchers) is also a key factor affecting library performance. Hence, the development quality of university libraries is closely related to the sustainable and stable development of all higher education. Fu [4] proposed that "the library is the heart of a university" and highlighted university libraries' important position on

campuses. University libraries have an important position, mainly because they can support teaching, research, and extension services and promote the overall research and development capacities of universities. Providing good services for university teachers and students is the starting point and ultimate goal of university libraries. Therefore, how to continuously provide correct and efficient services to all teachers and students is always the direction that university libraries pursue and strive to achieve [5].

The key research question that this study aims to answer is how non-state-owned university libraries can provide better services, adjust existing services, and enhance users' understanding of these services. However, library service quality assessments in the past stressed the relationships among resources, capabilities, utilizations, and effects rather than paying attention to users [6]. Parasuraman et al. [7] indicated that the SERVQUAL scale is highly effective when used for service quality assessments of the commercial field. Hence, some scholars are starting to use it for service quality assessments of libraries. Hebert [8] used it to investigate the service quality of interlibrary loans between large public libraries. Wisniewski [9] assessed the service quality of public libraries in the UK. Moreover, overlapping issues may appear in some aspects of quality [10]. Dennis et al. [11] updated an earlier 2010 longitudinal study of LibQUAL+™ qualitative and quantitative data from the University of Mississippi libraries.

Tajer [12] used the LibQUAL+™ model to assess the service quality of university libraries. Cabrerizo et al. [13] suggested that the LibQUAL+™ model has two major defects and used fuzzy language to correct them. Raza and Samim [14] showed that students have higher expectations for library services. Ramezani et al. [15] used the LibQUAL+™ model to assess library service quality at Iranian universities, and the results showed that users' overall assessment of library quality is high. They used the LibQUAL+™ model to establish the assessment criteria system to determine the service quality of university libraries. Hunter and Perret [16] found that users of larger, better-funded libraries have higher expectations for information resource availability but not higher satisfaction scores. Additionally, there was no significant correlation between library usage statistics and user satisfaction. To assess the service quality of academic libraries, it is essential to determine key dimensions for evaluating service quality and satisfaction based on the available literature.

Authors such as Hu et al. [17] studied the factors influencing users' perception of university digital libraries in China using the structural equation model. Most studies in Chinese on service quality assessment focus on the service quality of "211" and "985" key national university libraries in China, but fewer studies have been conducted on the academic service quality of non-state-owned universities. With investments in information technology, university libraries gradually develop towards being more intelligent and networked, which not only greatly improve the library management level and service quality but also make library functions more professional and diversified.

Moreover, in China's non-state-owned colleges, there is a lack of electronic access to academic services, less literature discussion, and a lack of tools available to assess the quality of web-based library academic services—as determined by Hernon and Calvert [18]—making it difficult to evaluate the extent to which academic services provided by the library meet the needs and requirements of users. Few studies in the literature have examined the concept of academic service quality in a non-state-owned university environment, and none explore whether a comprehensive view of service quality can lead to the increased use of library academic network services.

To summarize, the importance of competition and service resources provided by information services is increasing; users may prefer to use other non-library internet services [19]. Different cultural values may also affect customer perception and service experience [20]. Digital skill divides still exist, which means that library services are difficult to evaluate under the influence of the information and communication technologies (ICTs) environment, which was determined by Ben Youssef et al. [21]. Additionally, few studies have examined the existence of academic services in the private school environment in

China, and there is little discussion about whether a comprehensive view of service quality can lead to an increase in the quality of library services.

The research objectives are:

(1) To identify the key attributes of the dimensions of perception-based library academic service quality.
(2) To determine the relative importance of the perceived library service quality to the overall service quality.
(3) To evaluate a library academic service quality model focusing on the expectation factor from the customer satisfaction matrix to improve the service quality of libraries.

The remainder of this paper is structured as follows: Section 2 provides a literature review, discusses the assessment of service quality, and presents the models for measuring users' satisfaction with library services. Section 3 describes the samples and methods. Section 4 summarizes the findings and discusses the results. Section 5 concludes the paper.

2. Literature Review

2.1. Service Quality

The assessment of service quality and its content has been debated by the academic community. Producers believe that quality comes from producing the best products with the most economical means [22]. Additionally, such products will attract consumers' positive attention and offer consistent specifications. In order to measure product quality better, enterprises formulate standard procedures and product specifications for their product quality assessment standard. Lehtinen and Lehtinen [23] indicated that service quality mainly comprises process quality and result quality. Cronin and Taylor [24] proposed that service quality is the difference between the desired services and the perceived services that are actually received. There is also the web-based quality of service, defined as services provided through information and communication technologies [25–27]. Lancaster and López [28] find satisfaction as the difference between service expectations and perceived performance. SERVQUAL and ES-QUAL [29] both measure the quality of electronic services. However, the number of dimensions to measure the quality of service and the interrelationships between these dimensions are problematic [29,30]. Malik and Malik [31] found that a disparity between the expectations and perceptions of respondents using a measure of SERVQUAL indicates that the library should enhance its services, especially in staff.

Most studies use quality of service tools from the commercial and market sectors, particularly SERVQUAL, SERVPERF, and e-SERVQUAL, which may not be applicable to non-profit library services in higher education. The most commonly used quality of service measurement tool in libraries and information services is LibQUAL+™. However, the quality of service is also an inconsistent measure of the level of match between service levels and customer expectations [29] based on the inconsistency theory. Some of the main objections relate to the predictive power of instruments, the validity of the five-dimension structure, and the length of the questionnaire [23,32]. In addition, one of the benefits of measuring the quality of library services is the standardization of a measure across libraries [33].

2.2. LibQUAL+™

LibQUAL+™ has become an international standard tool for measuring library satisfaction. LibQUAL+™ was developed to address the cross-pressure from the university to understand the benefits of investing in its library during the changing period and to demonstrate the value and effectiveness of the services provided [34]. The literature on LibQUAL+™ focuses on the instrument itself, the reliability and effectiveness of the instrument, and the methods used to analyze and interpret quantitative findings. Early approaches to LibQUAL+™ works of literature focus on the quantitative analysis of survey results, qualitative analysis, and case studies. Few studies have used expert interviews of administrating LibQUAL+™ or combined quantitative and qualitative methods. Only

a few studies have studied LibQUAL+™ nationally or internationally, and most of their studies only discuss common patterns and experiences related to library assessment [35,36]. The goals of LibQUAL+™ are to help libraries better understand user perceptions of library service quality and enhance library staff members' analytical skills for interpreting and acting on data. Recently, studies of digital libraries (DLs) have contributed evaluation criteria to accessibility, usage of interface user engagement, and collection quality [37].

Researchers' expectations and requirements for better quality and functional library services are increasing, especially in academic digital libraries. Therefore, the main challenge is how to measure the performance of its digital library from the user's perspective and the extent to which its digital library meets user needs [38–40]. Several digital library quality assessment methods based on user perception have been proposed. These methods provide users with a perceived performance of the services provided by the academic digital library but do not give any suggestions for improvement [41]. Focusing on the behavioral intent relationships with user behavior and attitudes, in Berlak et al.'s paper [42], for instance, the use of the Unified Theory of Technology Acceptance and Use (UTAUT) was adopted. In a recent paper, Zeebaree et al. [43] proposed an extended UTAUT model for linkages between citizens' acceptance of e-government services and their expectations of their adoption and sustainability. Lněnička et al. [44] investigated the adoption of open government data among students and confirmed that six constructs facilitated significant relationships with behavioral intention. The rise of digital technology has had a major impact on the service of library quality. Masa'deh et al. [45] examined the impacts of e-textbooks on the academic achievement of university students in a bilingual environment in Jordan using structural equation modeling (SEM) analysis based on the theory of planned behavior (TPB). In this case, artificial intelligence (AI) was employed via five machine learning (ML) techniques.

To summarize, there is no unified conclusion about evaluating a system of library service quality, and thus the quality of the service of a library is difficult to measure and evaluate. These new technologies can make assessments of service quality easier in some ways; however, such modeling is unable to integrate these tools in a context of uncertainty and imprecision proposed by Lizarelli et al. [46]. The use of the fuzzy method in this study is an adaptable technique that deals with the problems of qualitative aspects, including expert opinions, of user satisfaction. Additionally, the fuzzy approach assists understanding by users when the context is fluid or the concepts are abstract, and it decreases the effects of noise [41].

3. Methodology

This study established the questionnaire by the Fuzzy Delphi Method (FDM) and used the Two-Dimensional Quality Method proposed by Kano et al. [47] to analyze the difference in the perception of the library academic service quality of non-state-owned universities, making it the basis for improving library service quality.

3.1. Fuzzy Delphi Method

In the traditional Delphi Method, many iterations of questionnaires are required to pursue the agreement of experts, but this consumes cost and time, and during the computational process, only intermediate data are taken as the range of expert opinions, leading to the neglect and distortion of expert opinions. Ishikawa et al. [48] imported the concept of fuzzy theory into the traditional Delphi Method. Its advantages are as follows.

(1) The expert opinions can be expressed completely.
(2) The number of surveys can be reduced, and time and expense can decrease.
(3) The fuzzy theory is more rational and desirable for expert cognition.
(4) The individual attributes proposed by experts can also be considered.

Through deduction of the fuzzy theory, the consensus is determined as a concept of an average number. Jeng [49] partially corrected this method and used two triangular fuzzy numbers to obtain G^i (see Figure 1), which is the importance value of expert consensus. It

is more objective and reasonable than the average obtained by using one triangular fuzzy number and reduces the number of repeated questionnaire surveys. The steps are below.

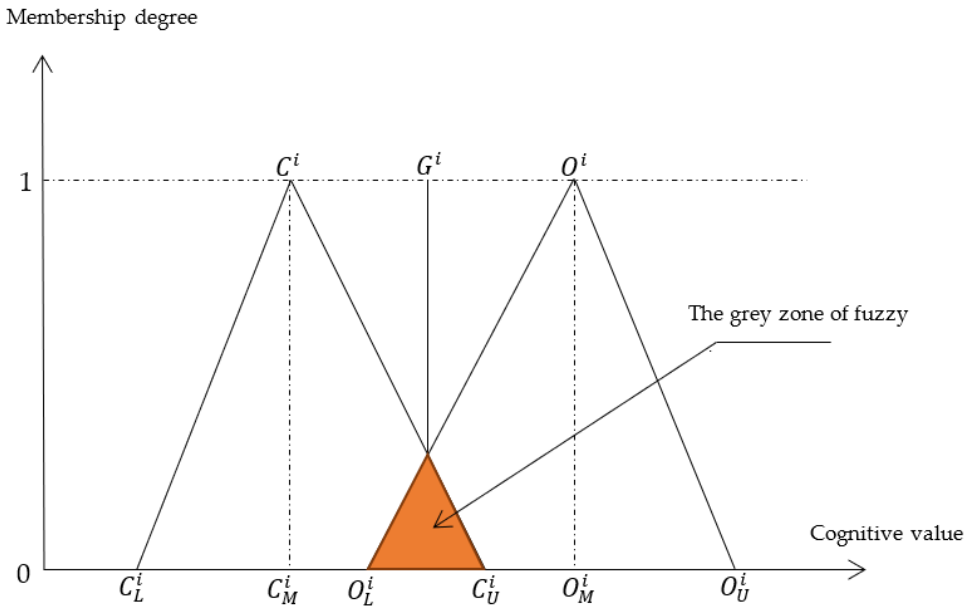

Figure 1. Double triangular fuzzy [49,50].

Step 1: Design a fuzzy expert questionnaire and form an expert group. Each expert is individually related to each assessment item and gives a numerical interval. In the numerical interval, the minimum value represents the expert's most conservative cognitive value for the quantitative fraction of the assessment item, and the maximum value represents the expert's most optimistic cognitive value for the quantitative fraction of the assessment item.

Step 2: In the following order, gather statistics on the most conservative cognitive value and the most optimistic cognitive value given by all the experts for each assessment item I; delete the extreme values outside twice the standard deviation; and then calculate the minimum value C_L^i, the geometric average C_M^i, and the maximum value C_U^i of the most conservative cognitive value as well as the minimum value O_L^i, the geometric average O_M^i, and the maximum value O_U^i of the most optimistic cognitive value.

Step 3: Obtain the most conservative cognitive triangular fuzzy number $C^i = (C_L^i, C_M^i, C_U^i)$ and the most optimistic triangular fuzzy number $O^i = (O_L^i, O_M^i, O_U^i)$ of each assessment item i built in Step 2.

Step 4: Verify whether the expert opinions reach a consensus; this can be judged in the following ways:

(1) It may be that two triangular fuzzy numbers are not overlapped ($C_U^i \leqq O_L^i$); this represents that the interval values of all expert opinions have a consensus segment and that the opinions tend to fall within the range of this consensus segment. In this way, the consensus importance value G^i of this assessment item i equals the arithmetic average of C_M^i and O_M^i (see Equation (1)).

$$G^i = \frac{C_M^i + O_M^i}{2} \tag{1}$$

(2) If two triangular fuzzy numbers are overlapped ($C_U^i > O_L^i$), and $Z^i = C_U^i - O_L^i$, the gray zone of fuzzy relation is less than $M^i = O_M^i - C_M^i$, the interval range of the optimistic cognitive geometric average, and the conservative cognitive geometric average of the expert assessment items. This represents that the interval values of all expert opinions have no consensus segment, but opinions are not divergent due to the big difference between the two experts' opinions with extreme values (the minimum value in optimistic cognition and the maximum value in conservative cognition) and other experts' opinions. In this way, the consensus importance value

G^i of this assessment item i equals the fuzzy set obtained from the intersection (mix) operation of the fuzzy relation of two triangular fuzzy numbers so as to determine the quantitative fraction of this fuzzy set with the maximum membership degree (see Equation (2)).

$$G^i = \frac{\left[\left(C_U^i \times O_M^i\right) - \left(O_L^i \times C_M^i\right)\right]}{\left[\left(C_U^i - C_M^i\right) + \left(O_M^i - O_L^i\right)\right]} \tag{2}$$

(3) If two triangular fuzzy numbers are overlapped ($C_U^i > O_L^i$), and $Z^i = C_U^i - O_L^i$, the gray zone of fuzzy relation is greater than $M^i = O_M^i - C_M^i$, which is the interval range of the optimistic cognitive geometric average and the conservative cognitive geometric average of the expert assessment items. This represents that the interval values of all expert opinions have no consensus segment, and opinions are divergent due to the big difference between the two experts' opinions with extreme values (the minimum value in optimistic cognition and the maximum value in conservative cognition) and other experts' opinions. These assessment items of the divergent opinions (the minimum conservative cognitive value O_L^i, the geometric average and the maximum value) and (the minimum optimistic cognitive value, the geometric average and the maximum value) are provided to experts as reference. Furthermore, Steps 1 to 4 are to be repeated for the next questionnaire survey until all the assessment items are convergent and the consensus importance value G^i is obtained.

3.2. Kano Two-Dimensional Quality Method

The concept of Two-Dimensional Quality comes from the Motivator–Hygiene Theory proposed by Kano et al. [47], Herzberg [51], and other scholars from Japan who employed the two-factor theory used for motivating employees to study service quality and proposed the Two-Dimensional Quality model. Their studies considered that customer satisfaction or dissatisfaction is not caused by the same aspect but by different aspects. In a separate discussion on customer satisfaction and dissatisfaction, Kano systematically organized customer demands in the first place to convert customer demands into products to improve enterprise competitiveness. Service quality is divided into five major categories (see Figure 2). First is the "Attractive quality element (A)": when this quality attribute element is inadequate, customers do not feel dissatisfied. However, with this quality element, customers would be satisfied. Second is the "One-dimensional quality element (O)": when this quality attribute element is more than adequate, customers feel more satisfied. In the case of lower adequacy, customers are less satisfied. Third is the "Must-be quality element (M)": when this quality attribute element is adequate, customers take it for granted, and their satisfaction is not increased with adequacy. In the case of inadequacy, customers feel dissatisfied. Fourth is the "Indifferent quality element (I)": regardless of whether the quality attribute element is adequate, customers do not care about it much and do not feel satisfied or dissatisfied. Fifth is the "Reverse quality element I": when the quality attribute element is more than adequate, on the contrary, customers feel less satisfied.

Quality attributes are classified by the Kano classification method, which Matzler and Hinterhuber [52] corrected (see Table 1) to divide quality elements into attractive quality, one-dimensional quality, indifferent quality, must-be quality, reverse quality, and invalid quality.

Table 1. Kano's evaluation model of teaching quality attributes questionnaire.

Library Quality		**Insufficiency**				
Student's Answer		**5**	**4**	**3**	**2**	**1**
Sufficiency	Satisfied (5)	Q	A	A	A	O
	Certainly (4)	R	I	I	I	M
	Irrelevant (3)	R	I	I	I	M
	Reluctantly (2)	R	I	I	I	M
	Dissatisfied (1)	R	R	R	R	Q

Notes: A: attractive; O: one-dimensional; M: must-be; I: indifference; R: reversal; Q: questionable.

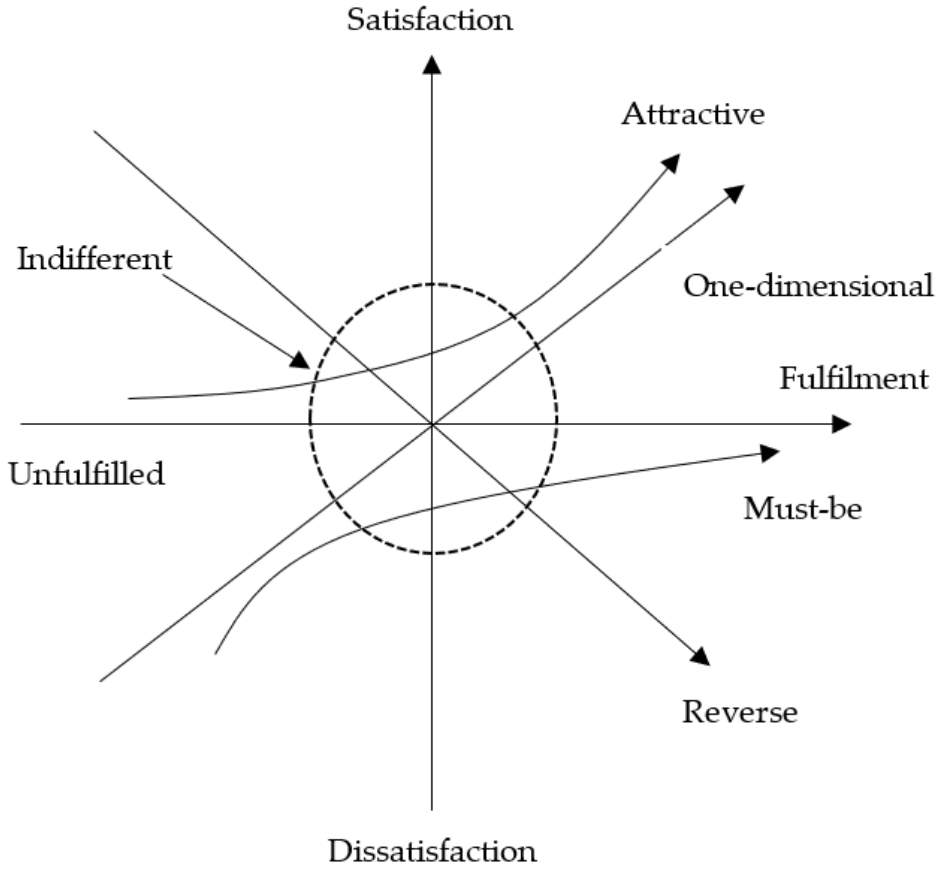

Figure 2. Kano's model (Kano et al., 1984) of quality attributes.

After correcting the Kano model and proposing the classification table of two-dimensional quality element correction, Matzler and Hinterhuber [52] proposed the customer satisfaction coefficient to determine how to improve some quality attribute elements and measured the increased Satisfaction Increment Index (SII) and Dissatisfaction Decrement Index (DDI). The results can be used as references to determine key service quality elements and improvement priority (Equations (3) and (4)):

$$SII = (A + O)/(A + O + M + I) \quad (3)$$

$$DDI = (O + M)/(A + O + M + I) * (-1) \quad (4)$$

(A: attractive, O: one-dimensional, M: must-be, I: indifference.)

After service element items are calculated and the SII and DDI of the questions of all dimensions are averaged, the obtained result is the general average of SII and DDI of all dimensions, and the key dimension is the highest one.

3.3. Research Subjects

Private higher education in China has gone through many changes since the 1990s. From the open government data in the past ten years (see Table 2), the proportion of non-state-owned Chinese universities among all national universities has grown sharply from 2007 (15.57%) to 2017 (28.39%). The proportion of enrolled students at non-state-owned universities to enrolled students at all national universities has continuously increased from 2007 (8.65%) to 2017 (22.82%) as well, indicating that non-state-owned universities recruit a large number of students each year and play an important role in meeting the needs of the current society for higher education. The research object is the non-state-owned university in Guangzhou. There were 17 non-state-owned universities in 2019. Excluding 2 incomplete data sets, there are 15 college survey data sets. Panel B shows an average of

about 16,000 students at school and houses over 1.5 million volumes of book collections and 1.5 million electronic collections. These data sources come from the National Bureau of Statistics of China (http://www.stats.gov.cn) (accessed on 1 July 2022).

Table 2. Non-state-owned universities in China.

Panel A: Development Situation of Non-State-Owned Universities						
Year	**University**	**Non-State-Owned**	**Percent**	**Student**	**Non-State-Owned**	**Percent**
2007	1908	297	15.57%	18,848,954	1,630,661	8.65%
2008	2263	640	28.28%	20,210,249	4,013,010	19.86%
2009	2305	658	28.55%	21,446,570	4,461,395	20.80%
2010	2358	676	28.67%	22,317,929	4,766,845	21.36%
2011	2409	698	28.97%	23,085,078	5,050,687	21.88%
2012	2442	707	28.95%	23,913,155	5,331,770	22.30%
2013	2491	718	28.82%	24,680,726	5,575,218	22.59%
2014	2529	728	28.79%	25,476,999	5,871,547	23.05%
2015	2560	734	28.67%	26,252,968	6,109,013	23.27%
2016	2596	741	28.54%	26,958,433	6,162,035	22.86%
2017	2631	747	28.39%	27,535,869	6,284,554	22.82%
Panel B: 15 non-state-owned universities in Guangzhou City						
Number of students in school		16,706				
Paper collections		1,535,778				
Electronic collections		1,154,950				

Source: National Bureau of Statistics of China (http://www.stats.gov.cn) (accessed on 1 July 2022).

Table 3 shows the sample data of respondents, including gender, grade, number of visits, and purpose in order to understand the distribution of library users. According to the survey results, the gender ratio of respondents was 49.1% for women and 50.9% for men. The proportion of freshmen was 19.9%, the proportion of sophomores was 22.3%, the proportion of juniors was 23.2%, and the proportion of seniors was 34.7%. The proportion of library users was 20.3% once per week, 37.1% twice a week, and 9.5% once per month. The proportion of library visits for borrowing or browsing leisure books and audio–visual materials and magazines was 18.3%; the proportion of professional books, audio–visual materials, and magazines was 28.5%; the self-study ratio was 28.3%; and the database usage rate was only 2.2%.

Table 3. Data description.

Background Variables	Items	Sample	Percentage
Gender	Male	235	51.9%
	Female	218	48.1%
Grade	Freshman	90	19.9%
	Sophomore	101	22.3%
	Junior	105	23.2%
	Senior	157	34.7%
Number of visits	Once a week	92	20.3%
	More than twice a week	168	37.1%
	Once a month	43	9.5%
	Two to three times a month	100	22.1%
	No more than 6 times a year	50	11.0%
Purpose of the visit	To borrow or browse leisure books, audio-visual materials and magazines	83	18.3%
	To borrow or browse professional books, audio–visual materials, and magazines	129	28.5%
	To find the information required by the teacher	59	13.0%

Table 3. *Cont.*

Background Variables	Items	Sample	Percentage
	To find information about further studies, exams, or employment	18	4.0%
	For academic activities	13	2.9%
	Self-study	128	28.3%
	Using the database	10	2.2%

Source: questionnaire results.

3.4. Private Expert Questionnaire

This study proposed a framework for library service quality assessment based on the literature, used the Fuzzy Delphi Method to design an expert questionnaire, and issued and collected questionnaires. At this stage, experts in relevant fields were employed to evaluate the importance of all the questions and to verify the expert validity of the questionnaire contents by e-mail. The initial questionnaire was then confirmed after correction based on an analysis of the expert questionnaire results to determine the applicability and validity of this study's questionnaire.

In this study, ten experts were invited to conduct expert validity verification on the content of the questionnaire, and the applicability of the library service index items was modified into a prediction questionnaire based on the results of the expert questionnaire to confirm the applicability and validity (see Table 4). Research experts who were chosen to participate had a Ph.D. and often used the library's academic resources services or were experts in professional knowledge and practical experience in library work. The distribution and collection of the Fuzzy Delphi Method expert questionnaire were carried out by e-mail, and the recovery rate was 100%.

Table 4. Expert decision-making for each interval value.

Most Conservative Cognitive Value	(1)	(2)	Most Optimistic Cognitive Value	(1)	(2)
Expert_1	6	7	Expert_1	10	10
Expert_2	6	6	Expert_2	10	10
Expert_3	4	7	Expert_3	7	10
Expert_4	6	6	Expert_4	10	10
Expert_5	7	7	Expert_5	10	10
Expert_6	3	2	Expert_6	10	9
Expert_7	4	4	Expert_7	8	9
Expert_8	5	5	Expert_8	10	10
Expert_9	5	7	Expert_9	10	10
Expert_10	5	6	Expert_10	10	10
Mean	5.1	5.7	Mean	9.5	9.8
S.D.	1.2	1.64	S.D.	1.08	0.42
S.D. (−2 times)	2.41	2.43	S.D. (−2 times)	7.34	8.96
S.D. (+2 times)	7.49	8.97	S.D. (+2 times)	11.67	10.64
Min (C_L)	3	4	Min (C_L)	8	9
Mean (C_M)	4.96	5.39	Mean (C_M)	9.44	9.79
Max (C_U)	7	7	Max (C_U)	10	10

Source: Expert questionnaire results.

The assessment method of this questionnaire mainly focuses on the individual's cognition of the scale of the score and gives a fuzzy interval value of 0 to 10 points. The higher the score, the more important the measurement item is. We can check the fuzzy relationship between the two fuzzy numbers to check whether the experts reached a consensus on the evaluation project. As shown in Table 5, if the verification value is greater than 0, the expert opinion reached a consensus. For the measurement projects that the experts suggested adding to or did not reach a consensus on, the next expert questionnaire was required, and the average opinion range of the experts was given to the experts for

reference until all the measurement projects reached a consensus. Generally, in the range of 0–10, the threshold value is 6–7. The screening principle of this study is 80% of the number of experts who agree to be included in the measurement project, and the expert consensus importance value of the indicator is the threshold value of 7. When the two conditions are established at the same time, the evaluation framework of the service quality of the library can be included.

Table 5. Expert opinions for consensus criteria.

Filter	(1)	(2)
Consensus value_G	7.59	8.34
Verification value_M-Z	5.47	6.40
Convergence	Yes	Yes
Suggested deletion	0	0

Source: Expert questionnaire results.

4. Results

According to the measurement index framework determined by the expert questionnaire, in total, 120 questionnaires were issued, and 100 valid questionnaires were collected. The effective rate of collected questionnaires was 83%. Cronbach's α coefficient shows that the Cronbach's α reliability of the forecast questionnaire was 0.968, and all dimensions were greater than 0.80 (see Table 6) and were adopted. The questionnaires were formally issued, and 505 questionnaires were collected, including 453 valid questionnaires, and the effective rate was 89.7%.

Table 6. Reliability analysis summary sheet.

Dimension	Item		Item Number	Cronbach's α after Items Are Deleted	
				Kano Model	
				Adequate Elements	Inadequate Elements
Emotional Service	1.	Librarians are friendly, warm, and polite	A1	0.871	0.890
	2.	Librarians are well-groomed and civilized	A2	0.862	0.885
	3.	Librarians' work behaviors are standardized and orderly	A3	0.891	0.869
	4.	Librarians are willing to assist users in all the problems they encounter in the library	A4	0.846	0.869
	5.	Librarians can answer questions from users at any time or online	A5	0.844	0.862
	6.	Librarians have enough knowledge and the use of academic resources for users	A6	0.867	0.868
	7.	Librarians reliably deal with users' problems	A7	0.854	0.864

Table 6. *Cont.*

Dimension	Item	Item Number	Cronbach's α after Items Are Deleted	
			Kano Model	
			Adequate Elements	Inadequate Elements
	8. Librarians pay attention to the opinions of users	A8	0.862	0.881
	Cronbach's α		**0.878**	**0.888**
Physical Environment	9. The library is comfortable and attractive academic environment	B1	0.915	0.875
	10. The library is quiet and users can concentrate on reading	B2	0.905	0.887
	11. The environment in the library encourages users to learn and seek knowledge	B3	0.921	0.866
	12. The library provides spaces for personal or a team to help with study or research	B4	0.923	0.874
	13. Sufficient academic resources for access	B5	0.927	0.890
	Cronbach's α		**0.934**	**0.901**
Information Control	14. Paper and electronic journals stored in the library can meet demands	C1	0.936	0.939
	15. Paper data can meet demands	C2	0.939	0.938
	16. Electronic data can meet demands	C3	0.942	0.938
	17. Library collections are effective in time and novel	C4	0.937	0.938
	18. Guides and marks in the library are clear, easy to understand, and convenient for users to obtain required resources	C5	0.937	0.936
	19. Computers and other devices can make it easier for users to search for the required information	C6	0.937	0.935
	20. The library website can enable users to find the required information	C7	0.941	0.935
	21. The reservation and renewal process of the library is convenient	C8	0.937	0.936

Table 6. *Cont.*

Dimension	Item		Item Number	Cronbach's α after Items Are Deleted	
				Kano Model	
				Adequate Elements	Inadequate Elements
	22.	Academic resources can be obtained through campus cooperation	C9	0.941	0.936
	23.	Electronic resources are available outside the library	C10	0.944	0.937
	24.	The library has an academic database teaching and learning camp	C11	0.940	0.938
	25.	Develop education and academic ethics for library use	C12	0.940	0.941
	Cronbach's α			**0.944**	**0.942**

Source: Questionnaire results.

4.1. Classification of the Kano Model Elements

The service quality items of the case library were classified according to Table 1, in which 25 quality items were, respectively, classified as attractive quality, one-dimensional quality, must-be quality, indifferent quality, and reverse quality. However, in the case of the same category of different two-dimensional quality attributes, the criterion of two-dimensional quality attribute classification is M > O > A > I [53].

4.2. Classification of Quality Elements

From the analysis of statistical results, library service quality items are classified as attractive quality, one-dimensional quality, and indifferent quality, excluding must-be quality and reverse quality. Furthermore, except for the information control dimension being classified as a one-dimensional quality and indifferent quality, emotional service and physical environment dimensions are of one-dimensional quality (see Table 7).

Table 7. Category of teaching quality attributes in Kano's model.

Dim.	Item	%					Class.	SII	DDI	Dim. Class.	SII Dim.	DDI Dim.
		A	O	M	I	R						
Emotional Service	A1	24.7	40.8	12.8	20.9	0.9	O	0.659	−0.541	**O**	0.668	−0.444
	A2	27.6	29.8	10.8	30.7	0	I	0.579	−0.410			
	A3	28.9	36.4	10.8	23.6	0	O	0.655	−0.473			
	A4	21.6	49.7	9.3	19.1	0	O	0.715	−0.591			
	A5	40.4	26.0	10.6	21.7	0	A	0.672	−0.371			
	A6	43.6	24.9	6.4	22.8	0.2	A	0.705	−0.318			
	A7	36.4	32.2	7.9	22.6	0	A	0.694	−0.404			
	A8	30.4	34.7	9.4	24.3	0.2	O	0.656	−0.444			
Physical Environment	B1	14.4	62.0	9.5	13.4	0.2	O	0.769	−0.720	**O**	0.736	−0.594
	B2	15.7	60.9	8.4	14.3	0.2	O	0.771	−0.698			
	B3	29.2	45.5	8.0	16.7	0	O	0.751	−0.538			
	B4	26.4	48.8	8.0	16.2	0.2	O	0.756	−0.570			
	B5	21.9	48.8	12.2	16.4	0	O	0.711	−0.613			

Table 7. *Cont.*

Dim.	Item	%					Class.	SII	DDI	Dim. Class.	SII Dim.	DDI Dim.
		A	O	M	I	R						
Information Control	C1	31.9	33.6	9.3	24.2	0	O	0.661	−0.432	**O/I**	0.632	−0.431
	C2	30.8	29.6	7.9	31.3	0	A	0.608	−0.375			
	C3	32.2	32.0	8.1	26.9	0.2	A	0.647	−0.404			
	C4	34.7	22.3	6.2	36.3	0	I	0.572	−0.286			
	C5	21.7	54.3	10.2	13.1	0.2	O	0.764	−0.649			
	C6	25.5	49.7	8.8	15.5	0	O	0.756	−0.589			
	C7	29.6	40.0	7.9	21.9	0	O	0.700	−0.480			
	C8	28.7	37.3	8.3	24.8	0.4	O	0.664	−0.460			
	C9	31.1	28.7	6.1	33.2	0.4	I	0.601	−0.353			
	C10	29.1	22.7	5.7	40.0	1.0	I	0.532	−0.292			
	C11	22.3	33.6	8.1	34.8	0.4	I	0.565	−0.422			
	C12	24.2	18.1	6.9	49.2	0.8	I	0.430	−0.253			

Note: M: Must-be quality; O: One-dimensional quality; A: Attractive quality; I: Indifferent quality.

The results are as follows:

1. Attractive quality: Respondents considered five service quality elements, A5, A6, A7, C2, and C3. Respondents suggested that they would be satisfied if the library offered the above service elements, and they would feel no difference or not mind in the case of inadequate supply. Consequently, at present, such services in the library are between the ordinary level and satisfactory level.
2. One-dimensional quality: There are 14 service quality elements, including A1, A3, A4, A8, B1, B2, B3, B4, B5, C1, C5, C6, C7, and C8. The actual operations of the case library are mostly the basic services that are the service items prioritized to be provided. The more adequate the quality attribute elements are, the more satisfied users are. Comparatively, the failure to provide such services immediately causes dissatisfaction, and the more inadequate the one-dimensional quality is, the less satisfied users are.
3. With the coming of the information age, users are improving their capabilities to use modern facilities to obtain information. Hence, the attribute of the three services, including C6, C7, and C8, is of one-dimensional quality. In this case, improvements are made by adding self-service borrowing and returning equipment and re-planning the library website.
4. Indifferent quality: Respondents considered six items, including A2, C4, C9, C10, C11, and C12. In this case, for Item A2, the service staff are basically student volunteers and have good images. Most respondents believe that this service quality element is adequate and has no effect on the satisfaction with the library service. Item C9 is about academic resources that can be obtained through campus cooperation. Inter-library cooperation service is a cooperative way to achieve resource sharing and make up for the lack of collections.

For "C11. The library has an academic database teaching and learning camp", whether this service element is provided adequately does not cause satisfaction or dissatisfaction. The library's database mainly provides tools and books, which can be used to query, browse, print, and download the required data and papers online, and has new functions such as diary notification, search notification, and citation notification. The library provides learning and learning database teaching camps, which help researchers to improve their work efficiency. However, due to the small number of users, statistics show that users are not paying much attention to this service.

For "C10. Electronic resources are available outside the library", less attention is paid to this service element because students can easily purchase electronic resources at inexpensive costs, which can be used immediately after payment.

For "C12. Develop education and academic ethics for library use", regardless of whether this service quality element is provided adequately, users' assessment of the

overall service quality of the library does not increase or reduce. Academic ethics education aims to cultivate good academic ethics in teachers and students of higher education and ensure the appropriateness and legitimacy of academic activities. In this study, teachers mentioned how they used library resources and emphasized the importance of academic ethics when teaching, but most users pay less attention to library conduct education.

4.3. Customer Satisfaction Coefficient

User satisfaction is crucial to the growth of enterprises [54]. The biggest enlightenment of the Kano model is the non-linear and asymmetric relationship between quality performance and user cognition. Traditionally, it is considered that a linear and symmetric relationship between both is just a special case, in fact, and the indices of quality improvement performance should be simultaneously considered from two perspectives, which are user satisfaction increment and user dissatisfaction decrement. In order to determine users' expectations for all library service quality elements, the user satisfaction coefficient is calculated to confirm the user satisfaction increment and user dissatisfaction decrement that can occur simultaneously when a quality element is improved (see Table 7). The closer the satisfaction increment index is to 1, the greater the effects of this element on user satisfaction are; the closer the absolute value of the dissatisfaction decrement index is to 1, the greater the effects of this element on user dissatisfaction decrement are.

After the user satisfaction coefficient of the service element items is obtained by calculation, the satisfaction increment coefficient and the dissatisfaction decrement coefficient are sorted (see Table 8). In the satisfaction increment coefficient, there are 10 service element items that need to be improved, which are "B2, B1, C5, B4, C6, B3, A4, B5, A6, and C7". These are the items that have a satisfaction increment coefficient and dissatisfaction decrement coefficient simultaneously with a value higher than the average number. Therefore, regardless of the aspects, just by improving these items, an efficiently upgraded service quality can be obtained.

Table 8. User satisfaction index sort.

SII sort		**DDI sort**	
Item Number	**SII**	**Item Number**	**DDI**
B2	0.771	B1	0.720
B1	0.769	B2	0.698
C5	0.764	C5	0.649
B4	0.756	B5	0.613
C6	0.756	A4	0.591
B3	0.751	C6	0.589
A4	0.715	B4	0.570
B5	0.711	A1	0.541
A6	0.705	B3	0.538
C7	0.700	C7	0.480
A7	0.694	A3	0.473
A5	0.672	C8	0.460
C8	0.664	A8	0.444
C1	0.661	C1	0.432
A1	0.659	C11	0.422
A8	0.656	A2	0.410
A3	0.655	C3	0.404
C3	0.647	A7	0.404
C2	0.608	C2	0.375
C9	0.601	A5	0.371

Table 8. *Cont.*

SII sort		DDI sort	
A2	0.579	C9	0.353
C4	0.572	A6	0.318
C11	0.565	C10	0.292
C10	0.532	C4	0.286
C12	0.430	C12	0.253
Mean value	0.664	Mean value	0.467

Note: Gray bottom greater than the mean value.

4.4. User Satisfaction Matrix

In order to show the significance of the user satisfaction coefficient more clearly, when measuring service quality and strengthening the primary key attributes, this study established the user satisfaction matrix and took the satisfaction increment coefficient as the horizontal axis, dissatisfaction decrement coefficient as the vertical axis, and the individual general average of satisfaction increment coefficient and dissatisfaction decrement coefficient as the cross-point (see Table 8) in order to divide the coefficient distribution chart of all the questions into four quadrants and draw the locations of individual elements. Figure 3 shows the preferential improvement items of library quality elements.

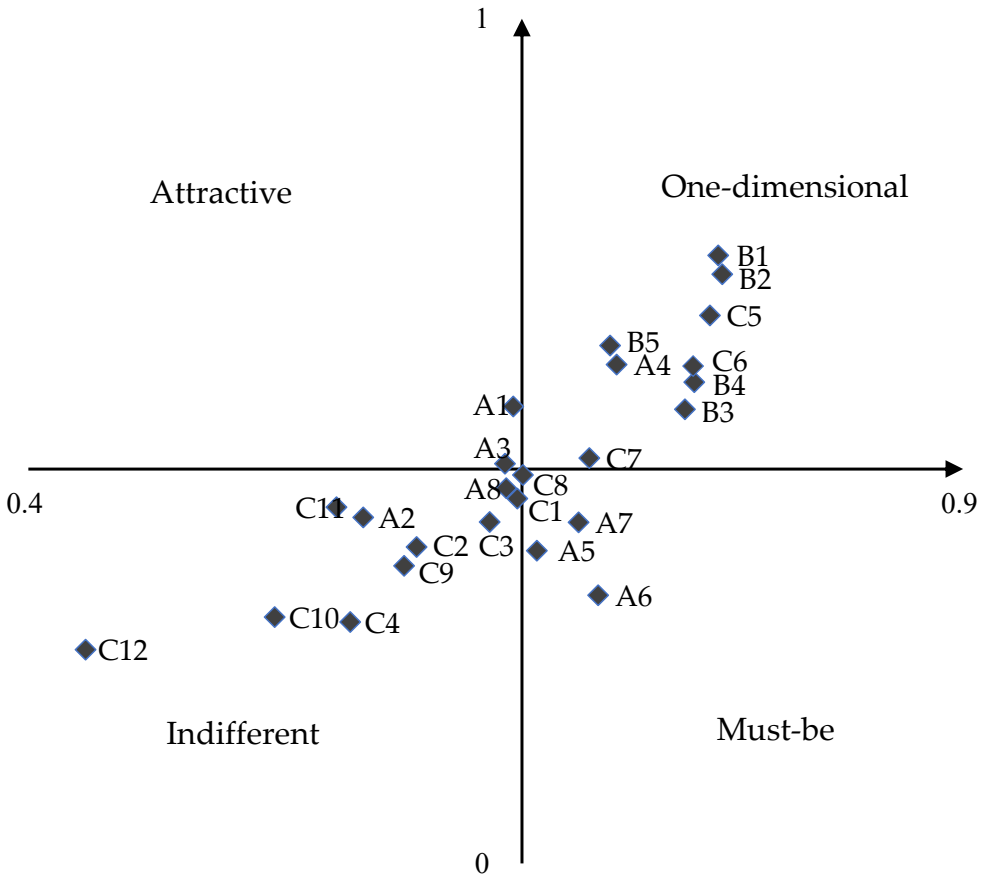

Figure 3. Kano's model [47] of quality attributes.

The elements in the first quadrant indicate that they highly increase user satisfaction and decrease user dissatisfaction, so more resources should be invested to improve these service elements. The elements in the second quadrant slightly increase user satisfaction, eliminate user dissatisfaction, and the essential elements can be maintained at a certain level. The elements in the third quadrant are not very helpful for increasing satisfaction value and decreasing the dissatisfaction value. Even if a lot of manpower and materials are

devoted to improving the quality of these services, the overall efficiency is not enhanced. Therefore, it is not necessary to put much effort into these service elements. The elements in the fourth quadrant can increase user satisfaction but cannot eliminate dissatisfaction.

In Figure 3, the priority to improve service quality elements can be determined according to the features of the quadrant, including 25 quality elements. The first quadrant shows that it highly increases satisfaction and decreases dissatisfaction, and nine items are expectation factors: A4, B1, B2, B3, B4, B5, C5, C6, and C7. The quality attributes in this zone both increase motivation factors of user satisfaction and decrease hygiene factors of user dissatisfaction. Hence, the library should invest more resources into improving these quality elements, and administrators should prioritize improving the quality elements in this zone.

The quality elements in the second quadrant are attractive factors, including two items, A1 and A3. With the effects of hygiene factors, the two items can decrease the dissatisfaction coefficient and slightly increase user satisfaction but can also eliminate user dissatisfaction. These service elements should be maintained at a certain level. The administrators should first invest resources to eliminate the causes of user dissatisfaction.

The quality elements in the third quadrant are indifferent factors, including 10 items, A2, A8, C1, C2, C3, C4, C9, C10, C11, and C12. They slightly decrease the user dissatisfaction coefficient and increase the user satisfaction coefficient, and this zone is the quality attributes that users pay the least attention to. After the attributes in other zones are improved, if any, the extra resources can be invested into improving quality attributes.

The quality elements in the fourth quadrant are must-be factors, including three items, A5, A6, and A7. The effects of motivation factors can increase user satisfaction but have little effect on eliminating user dissatisfaction. Improving these service quality elements can increase user satisfaction but cannot reduce user dissatisfaction. The administrators can maintain a certain level of service and expect to improve the elements in this zone after the improvement of expectation factors and attractive factors.

4.5. Discussion

In this study, the three dimensions of the case library exhibit strictly speaking one-dimensional quality (see Table 7), indicating that all service items are, respectively, one-dimensional quality and attractive quality. Generally, in the traditional concept, the physical environment services of a library are regarded as basic services—that is, a library provides physical environment services as a matter of course, and adequate supply does not increase customer satisfaction; otherwise, customers would be dissatisfied. However, in this study, the classification of service quality attributes of the physical environment broke the existing concept that it is generally regarded as the essential quality. The gracious attitude and politeness of librarians are also signs of respect for users. Real-time response and correct feedback through online services is also a positive, friendly attitude. Similarly, librarians can solve problems correctly and are important factors for users to be respected.

As seen in Figure 3, there are nine elements in the first quadrant, covering, respectively, "A4. Librarians are willing to assist users in all the problems they encounter in the library"; "B1. The library is comfortable and attractive academic environment"; "B2. The library is quiet and users can concentrate on reading"; "B3. The environment in the library encourages users to learn and seek knowledge"; "B4. The library provides spaces for personal or a team to help with study or research"; "B5. Sufficient academic resources for access"; "C5. Guides and marks in the library are clear, easy to understand, and convenient for users to obtain required resources"; "C6. Computers and other devices can make it easier for users to search the required information"; and "C7. The library website can enable users to find the required information". The administrators should prioritize improving the quality elements in this zone, and user satisfaction with service quality can be significantly increased. Similarly, Bussell et al. [55] concluded that students' preference to learn on demand depends upon available resources that support this type of learning style.

The service elements in the improvement zone with the highest priority are "B4. The library provides spaces for personal or a team to help with study or research" and "B5. Sufficient academic resources for access". Therefore, with limited resources, administrators should improve these two elements as a priority to improve user satisfaction with the library service. With adequate resources, "A4. Librarians are willing to assist users in all the problems they encounter in the library", "B1. The library is comfortable and attractive academic environment", "B2. The library is quiet and users can concentrate on reading", "B3. The environment in the library encourages users to learn and seek knowledge", "B4. The library provides spaces for personal or a team to help with study or research", "C6. Computers and other devices can make it easier for users to search the required information", and "C7. The library website can enable users to find the required information" should be improved next. Regrettably, limited access to the internet, such as the Google web browser, results in a bias in the measurement of academic satisfaction. However, Google and Google Scholar are heavily relied upon for accessing information by graduate students, as proposed by Nicholas et al. [56].

5. Conclusions and Suggestions

The purpose of this study is to investigate the differences in the perception and quality of academic services in non-state-owned universities and to explore strategies for improving the quality of library services. The respondents submitted 453 valid questionnaires for the study based on the Kano model, the service quality attributes were classified, and the fuzzy analysis method was used to incorporate expert opinions and analyze the user satisfaction matrix.

The results suggest that friendly librarian service can convey confidence in the professional knowledge, strengthen the user's impression, and improve the service quality. The results indicate there is a disparity between the respondent's opinions and expectations. Additionally, the convenience of data acquisition, the effectiveness of problem-solving, and the comfort of the venue environment can significantly improve user satisfaction with service quality. In the case of limited resources, administrators should prioritize the improvement of research spaces and sufficient academic resources, such as e-textbooks, as proposed by Masa'deh et al. [45]. In addition, the use of academic resources and the provision of academic ethics education are relatively less used—which may be limited by the composition of students—resulting in the lessened concern of students and the quality of service not being affected in this survey. Hence, the order of library service improvement should give priority to one-dimensional quality service items, followed by attractive quality and must-be quality service items.

The results also provide nine elements to improve the quality of service and two major improvements to enhance the perception and difference of service quality. With the development of network technology, library management staff can overcome the library's system and service inadequacies, but they still need to be innovative and find new ways to promote their resources and services and strengthen their expertise. Although the library has successfully provided them with a good atmosphere, a large academic database, and other facilities, there is still room for improvement in staff training.

This study has some limitations. While this paper focused on undergraduates with faculty from non-state-owned universities, it might be worthwhile to examine teachers as users of other groups, user attributes in terms of frequency of usage, and training experiences with online instruction. Future research could examine the changing perceptions of other academic services as library services become more digital and impersonal under the current digitization and the COVID-19 pandemic environment. Guiding by these models, this study suggests that the role of digital capability for library administrators needs to be developed. Later studies can also reconsider using an extended UTAUT model proposed by Zeebaree et al. [43] to apply the concept of a suitability assessment for feedback according to expert opinions in different cases.

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References

1. Nitecki, D.A. Changing the concept and measure of service quality in academic libraries. *J. Acad. Librariansh.* **1996**, *22*, 181–190. [CrossRef]
2. Hernon, P. Outcomes are key but not the whole story. *J. Acad. Librariansh.* **2002**, *28*, 54–55. [CrossRef]
3. Kiran, K. Service quality and customer satisfaction in academic libraries: Perspectives from a Malaysian university. *Libr. Rev.* **2010**, *59*, 261–273. [CrossRef]
4. Fu, Y.H. University Library Centrality: An Old Metaphor and a New Concept. *J. Libr. Inf. Sci.* **2001**, *37*, 51–57. [CrossRef]
5. Chen, C.W.; Chen, M.W. A Study of Service Quality on the Users' Satisfaction and Reused Intention: An Example of an Academic Library. *J. Educ. Libr. Inf. Sci.* **2006**, *44*, 61–82. [CrossRef]
6. Buckland, M.K. *Library Services in Theory and Context*; Elsevier: Amsterdam, The Netherlands, 2014.
7. Parasuraman, A.; Zeithaml, V.A.; Berry, L.L. A conceptual model of service quality and its implications for future research. *J. Mark.* **1985**, *49*, 41–50. [CrossRef]
8. Hebert, F. Service quality: An unobtrusive investigation of interlibrary loan in large public libraries in Canada. *Libr. Inf. Sci. Res.* **1994**, *16*, 3–21. [CrossRef]
9. Wisniewski, M. Measuring service quality in the public sector: The potential for SERVQUAL. *Total Qual. Manag.* **1996**, *7*, 357–366. [CrossRef]
10. Yu, L.Z.; Gu, S.; Zhao, Z. SERVQUAL and quality assessment of library services: A review of research in the past decade. *J. Acad. Libr.* **2005**, *22*, 51–57. Available online: http://www.oaj.pku.edu.cn/wk3/syxk/EN/ (accessed on 1 July 2022).
11. Dennis, M.; Greenwood, J.; Watson, A. LibQUAL revisited: Further analysis of qualitative and quantitative survey results at the University of Mississippi. *J. Acad. Librariansh.* **2013**, *39*, 512–516. [CrossRef]
12. Tajer, P. Using LibQUAL+®as a qualitative method: Taking one Iranian academic library as an example. *Qual. Qual. Methods Libr.* **2017**, *3*, 173–181. Available online: http://www.qqml.net/index.php/qqml/article/view/127 (accessed on 1 July 2022).
13. Cabrerizo, F.J.; López-Gijón, J.; Martínez, M.A.; Morente-Molinera, J.A.; Herrera-Viedma, E. A fuzzy linguistic extended LibQUAL+ model to assess service quality in academic libraries. *Int. J. Inf. Technol. Decis. Mak.* **2017**, *16*, 225–244. [CrossRef]
14. Raza, M.M.; Samim, A. Measuring the Quality of Services in Maulana Azad Library, AMU, Aligarh: A Study. 2017. Available online: https://ir.inflibnet.ac.in/bitstream/1944/2076/1/47.pdf (accessed on 8 February 2022).
15. Ramezani, A.; Ghazimirsaeed, S.J.; Azadeh, F.; Bandboni, M.E.; YektaKooshali, M.H. A meta-analysis of service quality of Iranian university libraries based on the LibQUAL model. *P. Perform. Meas. Metr.* **2018**, *19*, 186–202. [CrossRef]
16. Hunter, B.; Perret, R. Can money buy happiness? A statistical analysis of predictors for user satisfaction. *J. Acad. Librariansh.* **2011**, *37*, 402–408. [CrossRef]
17. Hu, C.P.; Hu, Y.; Yan, W.W. An empirical study of factors influencing user perception of university digital libraries in China. *Libr. Inf. Sci. Res.* **2014**, *36*, 225–233. [CrossRef]
18. Hernon, P.; Calvert, P. E-service quality in libraries: Exploring its features and dimensions. *Libr. Inf. Sci. Res.* **2005**, *27*, 377–404. [CrossRef]
19. Griffiths, J.R.; Brophy, P. Student searching behaviour and the web: Use of academic resources and Google. *Libr. Trends* **2005**, *53*, 539–554. Available online: http://hdl.handle.net/2142/1749 (accessed on 1 July 2022).
20. Kiran, K.; Diljit, S. Modeling web-based library service quality. *Libr. Inf. Sci. Res.* **2012**, *34*, 184–196. [CrossRef]
21. Ben Youssef, A.; Dahmani, M.; Ragni, L. ICT use, digital skills and students' academic performance: Exploring the digital divide. *Information* **2022**, *13*, 129. [CrossRef]
22. Deming, W.E. *Quality, Productivity and Competitive Position*; MIT Press: Cambridge, UK, 1982.
23. Lehtinen, U.; Lehtinen, J.R. Two approaches to service quality dimensions. *Serv. Ind. J.* **1991**, *11*, 287–303. [CrossRef]
24. Cronin, J.J., Jr.; Taylor, S.A. Measuring service quality: A reexamination and extension. *J. Mark.* **1992**, *56*, 55–68. [CrossRef]
25. Bertot, J.C. World libraries on the information superhighway: Internet-based library services. *Libr. Trends* **2003**, *52*, 209–228. [CrossRef]

26. Henderson, K. Marketing strategies for digital library services: Digital directions. *Libr. Rev.* **2005**, *54*, 342–345. [CrossRef]
27. Fassnacht, M.; Koese, I. Quality of electronic services: Conceptualizing and testing a hierarchical model. *J. Serv. Res.* **2006**, *9*, 19–37. [CrossRef]
28. Lancaster, F.W.; López, E.M. If you want to evaluate your library. *Rev. Esp. Doc. Cient.* **1994**, *17*, 233. Available online: https://redc.revistas.csic.es/index.php/redc/article/view/1092 (accessed on 1 July 2022).
29. Parasuraman, A.; Zeithaml, V.A.; Malhotra, A. ES-QUAL: A multiple-item scale for assessing electronic service quality. *J. Serv. Res.* **2005**, *7*, 213–233. [CrossRef]
30. Chowdhary, N.; Prakash, M. Prioritizing service quality dimensions. *Manag. Serv. Qual. Int. J.* **2007**, *17*, 493–509. [CrossRef]
31. Malik, S.A.; Malik, S.A. SERVQUAL to measure perceptions and expectations of library users: A case study of a public university library of Pakistan. *Int. J. Educ. Manag.* **2015**, *9*, 303–322. [CrossRef]
32. Fagan, J.C. The dimensions of library service quality: A confirmatory factor analysis of the LibQUAL+ instrument. *Libr. Inf. Sci. Res.* **2014**, *36*, 36–48. [CrossRef]
33. Lane, F.C.; Anderson, B.; Ponce, H.F.; Natesan, P. Factorial invariance of LibQUAL+®as a measure of library service quality over time. *Libr. Inf. Sci. Res.* **2012**, *34*, 22–30. [CrossRef]
34. Megwalu, A. LibQUAL+ and LibQUAL Lite. *Charlest. Advis.* **2019**, *20*, 34–39. [CrossRef]
35. Hiller, S.; Kyrillidou, M.; Self, J. Assessment in North American research libraries: A preliminary report card. *Perform. Meas. Metr.* **2006**, *7*, 100–106. [CrossRef]
36. Curtis, D.; Dean, H. Impact and performance measurement in library services. *Perform. Meas. Metr.* **2004**, *5*, 90–95. [CrossRef]
37. Zhang, Y. Developing a holistic model for digital library evaluation. *J. Am. Soc. Inf. Sci. Tec.* **2010**, *61*, 88–110. [CrossRef]
38. Heradio, R.; Fernández-Amorós, D.; Cabrerizo, F.J.; Herrera-Viedma, E. A review of quality evaluation of digital libraries based on users' perceptions. *J. Inf. Sci.* **2012**, *38*, 269–283. [CrossRef]
39. Heradio, R.; Cabrerizo, F.J.; Fernández-Amorós, D.; Herrera, M.; Herrera-Viedma, E. A fuzzy linguistic model to evaluate the quality of library 2.0 functionalities. *Int. J. Inf. Manag.* **2013**, *33*, 642–654. [CrossRef]
40. Lai, C.F.; Chiu, P.S.; Huang, Y.M.; Chen, T.S.; Huang, T.C. An evaluation model for digital libraries' user interfaces using fuzzy AHP. *Electron. Libr.* **2014**, *32*, 83–95. [CrossRef]
41. Cabrerizo, F.J.; Morente-Molinera, J.A.; Pérez, I.J.; López-Gijón, J.; Herrera-Viedma, E. A decision support system to develop a quality management in academic digital libraries. *Inf. Sci.* **2015**, *323*, 48–58. [CrossRef]
42. Berlak, J.; Hafner, S.; Kuppelwieser, V.G. Digitalization's impacts on productivity: A model-based approach and evaluation in Germany's building construction industry. *Prod. Plan. Control* **2021**, *32*, 335–345. [CrossRef]
43. Zeebaree, M.; Agoyi, M.; Aqel, M. Sustainable adoption of E-Government from the UTAUT perspective. *Sustainability* **2022**, *14*, 5370. [CrossRef]
44. Lněnička, M.; Nikiforova, A.; Saxena, S.; Singh, P. Investigation into the adoption of open government data among students: The behavioural intention-based comparative analysis of three countries. *Aslib J. Inf. Manag.* **2022**, *74*, 549–567. [CrossRef]
45. Masa'deh, R.E.; AlHadid, I.; Abu-Taieh, E.; Khwaldeh, S.; Alrowwad, A.A.; Alkhawaldeh, R.S. Factors influencing students' intention to use E-textbooks and their impact on academic achievement in Bilingual environment: An empirical study Jordan. *Information* **2022**, *13*, 233. [CrossRef]
46. Lizarelli, F.L.; Osiro, L.; Ganga, G.M.; Mendes, G.H.; Paz, G.R. Integration of SERVQUAL, Analytical Kano, and QFD using fuzzy approaches to support improvement decisions in an entrepreneurial education service. *Appl. Soft Comput.* **2021**, *112*, 107786. [CrossRef]
47. Kano, N.; Seraku, N.; Takahashi, F.; Tsuji, S. Attractive quality and must-be quality. *J. Jpn. Soc. Qual. Control* **1984**, *14*, 39–48. Available online: http://ci.nii.ac.jp/naid/110003158895/en/ (accessed on 1 July 2022).
48. Ishikawa, A.; Amagasa, M.; Shiga, T.; Tomizawa, G.; Tatsuta, R.; Mieno, H. The max-min Delphi method and fuzzy Delphi method via fuzzy integration. *Fuzzy Sets Syst.* **1993**, *55*, 241–253. [CrossRef]
49. Jeng, T.B. Fuzzy Assessment Model for Maturity of Software Organization in Improving Its Staff's Capability. Master's Thesis, National Taiwan University of Science and Technology, Taipei, Taiwan, 2001. Available online: https://hdl.handle.net/11296/6p8v6h (accessed on 1 July 2022).
50. Lin, J.H.; Yang, C.J. Applying analytic network process to the selection of construction projects. *Open J. Soc. Sci.* **2016**, *4*, 41. [CrossRef]
51. Herzberg, F. *The Motivation to Work*; John Wiley and Sons: New York, NY, USA, 1959. [CrossRef]
52. Matzler, K.; Hinterhuber, H.H. How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. *Technovation* **1998**, *18*, 25–38. [CrossRef]
53. Berger, C.; Blauth, R.; Boger, D.; Bolster, C.; Burchill, G.; DuMouchel, W. Kano's methods for understanding customer-defined quality. *Ctr. Qual. Manag. J.* **1993**, *2*, 3–35.
54. Fonvielle, W. How to know what customers really want. *Train. Dev.* **1997**, *51*, 40–44. Available online: https://link.gale.com/apps/doc/A20402220/AONE?u=anon~{}9ba986e9&sid=bookmark-AONE&xid=69a34207 (accessed on 1 July 2022).

55. Bussell, H.; Hagman, J.; Guder, C.S. Research needs and learning format preferences of graduate students at a large public university: An exploratory study. *Coll. Res. Libr.* **2017**, *78*, 978. Available online: https://journals.acrl.org/index.php/crl/article/view/16792/18354 (accessed on 1 July 2022). [CrossRef]
56. Nicholas, D.; Boukacem-Zeghmouri, C.; Rodríguez-Bravo, B.; Xu, J.; Watkinson, A.; Abrizah, A.; Herman, E.; Świgoń, M. Where and how early career researchers find scholarly information. *Learn. Publ.* **2017**, *30*, 19–29. [CrossRef]

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The Chemical Training of Agrarian Specialists: From the Chemicalization of Agriculture to Green Technologies

Marina Grigoryeva [1,*], Inna Dmitrevskaya [1], Sergey Belopukhov [2] and Alla Osipova [1]

[1] Department of Chemistry, Russian State Agrarian University—Moscow Timiryazev Agricultural Academy, 127550 Moscow, Russia; i.dmitrevskaya@rgau-msha.ru (I.D.); osipova@rgau-msha.ru (A.O.)
[2] Institute of Agrobiotechnologies, Russian State Agrarian University—Moscow Timiryazev Agricultural Academy, 127550 Moscow, Russia; sbelopuhov@rgau-msha.ru
* Correspondence: m.grigorieva@rgau-msha.ru; Tel.: +7-904-328-65-61

Abstract: The impact of agricultural production on the ecological condition of vast territories is of concern to the entire world community. Therefore, the concept of sustainable development should become the basis for the training of agricultural specialists. This article examines the transformation of the system of chemical training of agricultural students in Russia, taking into account the transition to the concept of sustainable development. The study of the history of the development of chemical training of agricultural specialists in Russia helped us to see the causes of the current crisis and highlights what should be preserved. The analysis of the modern needs of the agro-industrial complex made it possible to identify ways to modernize the system of teaching chemical disciplines in agricultural universities. As a result, the main trends of modernization of chemical training of future agricultural specialists in the context of the concept of sustainable development are identified. The chemical competencies of specialists of the agro-industrial sector working in the field of production, processing, and quality control of agricultural products are differentiated. The conditions of their formation are determined, and the effectiveness of the application of the principles of green chemistry for the formation of selected competencies is shown. The theoretical significance of the research is the development of the concept of ecological chemical education (green chemistry) for agricultural education. The practical significance of this work lies in the development of practical examples of the application of the principles of green chemistry in the educational process of an agrarian university. The originality of this research lies in determining the pedagogical conditions for the formation of chemical competencies of agricultural specialists in the context of orientation to the concept of sustainable development.

Keywords: agricultural education; chemical training; ecological agriculture; green chemistry; sustainable development; history of chemical education

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1. Introduction

At present, the attitude toward natural resources is changing the paradigm. Many teachers and researchers from all over the world are studying ecological education policies, such as Glackin and King [1], Payne [2], Reid [3], Rickinson and Mackenzie [4], Bylund [5], and many others. Mulder and Kupper [6] and Liberloo et al. [7] considered the issues related to the ecologization of agrarian education. Grigoryeva [8], Liberloo et al. [7], Koutsouris [9], Vic et al. [10], Lambrechts et al. [11], and MacGregor [12] have researched issues in creating a new agrarian education based on the concept of sustainable development. Other issues that interfere with the development of ecological agriculture are the topics, for example, of papers by Vermunt [13] and Dorin [14]. Emendu [15] and Fanzo et al. [16] have proven the crucial role of chemical knowledge in solving food-related and other problems. Some researchers have focused on improving the education process with regard to the chemical training of agrarian university students [17–20].

Green chemistry education (GCE) is currently being actively developed in many countries. It is a trending topic of research in books [21] and scientific papers [22–25]. It is most often considered in relation to economy, management, industry, systemic approach, education technologies, and specific branches of chemistry (e.g., catalytic processes). The current paper is devoted to the chemical training system in agricultural universities, taking into account its specificity, especially as far as green chemistry is concerned.

This represents a problem in the Russian educational system that has not been researched enough. Tarasova et al. [26] present a review of all the Russian organizations dealing with sustainable and environmental chemical training. According to them, despite the necessity for sustainable chemical training in Russia, as confirmed by statistical data and governmental initiatives, this issue still needs much work. A small think tank of researchers from different Russian universities (in particular, from Moscow Lomonosov State University) is actively researching this field. This paper describes the ways in which these universities are introducing the principles of "green chemistry" in the educational process of students from chemical faculties. Lunin et al. [27] present and analyze the summary of the master's degree program "Chemistry for the benefit of sustainable development", which is currently being implemented at Moscow Lomonosov State University. Kustov and Beletskaya [28] illustrate examples of the application of the principles of green chemistry in the educational process of students from the chemical faculty of the same university. Particular attention is devoted to catalytic processes. Lokteva [29] studies the motivation in students from Moscow Lomonosov State University when applying the approaches of "green chemistry" in their research. To promote the principles of sustainable development among youth, Lokteva suggests including exercises on "green chemistry" in the skills contests held at the university. She also highlights how online training in the field of green chemistry is particularly effective in vast countries such as Russia.

Thus, we can see that issues regarding the ecologization of the chemical training are not being elaborated as far as students from agricultural universities are concerned.

However, adequate chemical training is necessary for future agrarian specialists to apply the principles of green economy. This task is of crucial importance for teachers working at agrarian universities all over the world. Let us consider research conducted by teachers from Russian agrarian universities.

Russia is a vast country with a well-developed agricultural system and an important exporter of agricultural commodities [30]. Historically, Russia has always been an agricultural country. Nonetheless, Russian agriculture has had to face different crises over the centuries, but it always found a way to recover. Agrarian education played a key role in this respect. Nowadays, the Russian system of higher agrarian education includes 54 universities and more than 30 agricultural faculties and institutes in non-specialized universities. The number of students accounts for more than 300,000 people every year. Russian higher agrarian education has a rich history, which brought great scientific achievement in the fields of agrochemistry and chemistry as well. The transformation of the chemical training system for Russian agrarian specialists is a rich experience that can be applied for great numbers of students and thus can be interesting for other countries as well.

One of the first tasks that arises when implementing ecological farming is the educational work and training of personnel who can competently understand, elaborate, and implement their ideas in agriculture. Even though one of the principles of ecological farming is the restriction or complete exclusion of the use of agrochemicals that are aggressive towards the environment, such as pesticides (herbicides, insecticides, rodenticides, and fungicides) and chemical fertilizers, the importance of the training of future specialists in this field does not diminish. The emphasis and required chemical competencies have changed. The importance of some sections of chemical disciplines is enhanced or reduced. The chemical training of specialists for current ecological farming requires revisions and changes.

To implement the conception of sustainable development in the agro-industrial sector, corresponding specialists are needed. Having different levels of education (undergraduate,

graduate, and postgraduate), they should be able to deeply understand the processes and to identify highly technological approaches to solve the current ecological problems and prevent possible ones in the future.

The components of the pedagogical system need to be systematized and structurized when implementing the bases of green chemistry in the educational process as regards different chemical disciplines taught to students at an agrarian university. This substantiates the crucial importance of the current research.

The purpose of the study was to identify ways to modernize the system of chemical training of students at agricultural universities in the context of the concept of sustainable development.

This process included the following tasks:

- Analysis of the century-and-a-half history of chemical training in Russian agrarian universities to determine the causes of the current crisis and to identify the "strengths" that should be preserved;
- Identifying the main trends in the modernization of chemical training;
- Examples of the implementation of chemical training systems based on the concept of sustainable development.

2. Materials and Methods

The philosophical and psychological conceptions of professional activity are the methodological bases of the research, along with different methodological approaches, such as systemic, competence-oriented, pragmatic, and acmeological, used in education. In particular, we referred to specialist modeling theory (V.S. Gershunskii, A.A. Rean, and N.F. Talyzina), theoretical foundations for the formation of the structure and content of professional education (Yu.K. Babanskii, V.P. Bespalko, V.S. Lednev, I.Ya. Lerner, M. N. Skatkin, and others), and the general concept of chemical training and teaching of chemical disciplines (M. V. Gorskii, O. S. Zaitsev, A. A. Makarenya, M. S. Pak, V. V. Sorokin, N. N. Surtaeva, G. M. Chernobelskaya, and others).

The concept of sustainable development and the principles of green chemistry are the methodological background of this research. In particular, we referred to the position of G. Harlem Brundtland, which determines the tasks of sustainable development, along with the principles of green chemistry formulated by Anastas and Warner.

The results of this research have been introduced at the Russian State Agrarian University—Moscow Timiryazev Agricultural Academy. To assess the effectiveness of the implemented system, the control and experimental groups were tested to determine the level of competence in the field of green chemistry. When evaluating the results of the study, we used statistical methods, and the criterion χ^2 was used to determine the reliability of the differences.

3. Results

3.1. How Was the Chemical Training System Formed in Russian Agrarian Universities?

The history of the systematic chemical training of agrarian students in Russia dates back more than 150 years. Some key figures led the way for the development of the chemical training of agrarian specialists in Russia in the XIX century. They were the disciples of European scholars who influenced their activities. In particular, two professors laid the foundation for the chemical training system at the first Russian agrarian university: P.A. Ilyenkov and N.E. Lyaskovskii. They were both students of the famous German chemist Justus von Liebig. Professor E.B. Schöne had studied in Berlin, where he was the apprentice of the famous German scholars Heinrich Rose and Karl Rammelsberg. The German Chemical School has become the basis for chemical training. It had a fundamental and universal nature and included an in-depth study of the basics, a wide application of chemical experiments, and demonstrations of experiments during lectures. The content and methods of chemical disciplines were similar to those taught in traditional, non-specialized

universities. The students studied inorganic, analytical, and organic chemistry, as well as agricultural analysis.

The twentieth century saw the formation of a teaching system suitable for teaching a great number of students. Many agrarian universities have been founded throughout the country. The number of agrarian specialties has increased. The curricula on chemical disciplines were released on a centralized basis for all agrarian universities in the country. This period coincides with the blossoming of intensive agriculture and its chemicalization. The main research trends regarded fertilizers, chemicals for plant protection, farmland improvement, and similar topics. Chemical training of agrarian specialists remains fundamental. Agrochemistry has undergone intensive development. New handbooks and textbooks on chemical disciplines were released, many of which were specially designed for teaching in agrarian universities.

During the second half of the XX century, it became clear that the chemicalization of agriculture and intensive agricultural technologies harmed the environment: toxic agents impoverished and contaminated the soil and polluted the water bodies [31]. Agriculture is no longer safe for human health because of pesticide residues in plant commodities, hormones in animal husbandry products, and similar problems [32]. The nutritional value of the output decreased [33]. The effect of "chemophobia"—the fear of chemicals—emerged in society [34].

All these issues escalated at the beginning of the XXI century. The teaching system is characterized by a negative trend, due to which the number of hours devoted to the study of chemical disciplines has been constantly declining. The main cause of this is the economic recession that the country had to face. The number of contact hours (in class) is reduced. This led to a reduction in the share of chemical experiments in the teaching process. The nature of chemical training is no longer fundamental but more superficial. In most agrarian universities, the departments of chemistry are no longer independent and have been integrated with other structural units. Chemical training is reduced to a superficial study of the bases of chemistry. To preserve the quality of education despite the limited number of teaching hours, teachers are using new pedagogic and information technologies. Handbooks and textbooks are constantly being improved. Some of them discuss specialized content issues for agriculture in great detail. In addition, the chemical training of agrarian specialists is facing a crisis with regard to its content. At present, specialists in the agro-industrial sector must be competent in issues related to chemical substances and processes. This has been confirmed by enquiries among employers and specialists in the agro-industrial sector [8].

Thus, we were able to identify the following historical phases in the development of the chemical training system in agrarian universities (Table 1).

Table 1. Phases of the development of the teaching system of chemical disciplines in Russian agrarian universities.

	Development Phases	Key Concepts and Innovations	Content of Chemical Disciplines	Methodological Aspects
1.	Origin and establishment (1865–1920)	Borrowing of the teaching system from other universities and laboratories and adaptation to their specific goals. This leads to the formation of the classical university system for teaching chemical disciplines.	Classical university courses in inorganic, organic, and analytical chemistry.	Many hours divided between lectures, laboratory practicums, and lectures/demonstrations. Students do not engage in research activities. The chemistry handbooks published in this phase are not specialized for agrarian universities.

Table 1. *Cont.*

	Development Phases	Key Concepts and Innovations	Content of Chemical Disciplines	Methodological Aspects
2.	Diffusion and chemicalization (1921–1990)	The teaching system aims at educating a great number of students. The curriculum focuses on the chemicalization of agriculture.	The fundamental nature of basic chemical education is preserved. Agrochemistry is flourishing. Fertilizers and pesticides are the main focus.	Programmed control. The chemistry handbooks are now specialized for agrarian specialties. Students are more engaged in research activities.
3.	Reduction of chemical training (1991–2005)	The ecological crisis leads to "chemophobia". The economic crisis leads to a search for the least possible expenses for education. Shift from a knowledge-based approach to a competency-based one.	Chemical training becomes weak and superficial.	The number of hours devoted to the study of chemical disciplines is reduced.
4.	Current phase (since 2006)	Orientation towards the concept of sustainable development and application of the principles of green chemistry.	Chemical disciplines interact with ecology. The role of physicochemical analytic methods increases.	Active use of project-based learning.

3.2. In Which Direction Is the System of Students' Chemical Training in Russian Agrarian Universities Developing at Present?

The last decade has witnessed active attempts at solving problems related to product safety and the preservation of territorial ecological well-being. The priorities of sustainable development, increasing competitiveness, and scientifically based greening of the country's agro-industry outlined by the President and the Government of Russia (Decree of the President of the Russian Federation of 1 December 2016, No. 642; Strategy for the development of agricultural education in the Russian Federation until 2030) actualize the priority tasks of development and improving the educational and methodological base of the step-by-step diversified training of high-quality agro-industry specialists of three qualification levels (bachelor's, master's, and candidates of science) in agricultural universities of Russia, capable and ready to reach the set goals.

The monitoring of the production quality was enhanced. Russia's accession to international unions, such as BRICS (China, Russia, Brazil, India, and South Africa, 2006) and the Eurasian Customs Union (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia, 2014), resulted in significant changes in the sphere of technical regulation of agricultural products. In turn, this creates a need for specialists in the agrobusiness who are proficient in methods of analysis.

Organic farming is being developed. On 1 January 2020, Federal Law No. 280-FZ "On Organic Products and on Amendments to Certain Legislative Acts of the Russian Federation" came into force. A paper by Grigoryeva and Belopukhov [35] presented the aspects of personnel's chemical training for organic farming. Attempts to implement green chemistry principles and green economy into agriculture are being made [36,37].

The chemical education of agrarian specialists requires modernization [38], which is confirmed by surveys conducted among working specialists [8]. There is a need to train specialists in the agro-industrial sector who possess the most modern methods of quality control and safety of agricultural products as well as specialists in the field of agro-ecological control.

3.3. Outlook Basis and Objectives

The 12 widely known principles of green chemistry were formulated by Anastas and Warner [39] and Anastas et al. [40,41]. They may be used in any production that is connected with the use of chemical processes. Most of these may be implemented in agriculture.

The main objectives of current eco-oriented farming are:

1. Providing consumers with ecologically safe top-quality agricultural production;
2. Preserving the ecological well-being of farmlands and surrounding areas and maintaining and improving soil fertility.

The abovementioned objectives create a list of tasks for farmers. Further, we will pay close attention to the group of tasks that require knowledge of chemistry to be solved:

(1) Diagnostics of characteristics, soil fertility, and identification of scarce elements, as well as elaboration of plans to improve soil quality. This criterion is being implemented both in intensive farming and in emerging evaluation methodologies of farming enterprises for organic production [42,43];
(2) Monitoring of soil conditions. With long-term use, soil fertility should not decrease. This is a key criterion for modern sustainable agricultural enterprises. Long-term observations of the soil conditions are necessary;
(3) Processing of agricultural products while applying methods that ensure environmental integrity and preserve the defining qualitative characteristics of products at all stages of the production chain;
(4) Product quality control proof of the absence of toxicants and proof of the presence of the necessary quantities of trace elements, vitamins, and other valuable nutrients for a given type of product [44];
(5) Solving the problem of agricultural waste utilization.

3.4. Main Directions of the Modernization of Future Agricultural Specialists' Chemical Training

Our research has shown that chemical training is different for three groups of professional areas (three groups of specialties):

(1) Farm specialists working with soil and plants (agronomists, soil scientists, and ecologists);
(2) Specialists involved in product processing (food production technologists, technologists of medicinal and essential oil raw materials, biotechnologists, etc.);
(3) Specialists working in laboratories for the quality control of raw materials and finished products.

The analysis of specialists' labor functions, goals, and tasks of ecology, surveys of working specialists [8], and the cooperation experience of the RSAU-MTAA Department of Chemistry with agricultural farms showed the most important chemical components of education: (1) basic chemical training that allows us to understand and manage the dynamic processes occurring in the agrosphere; (2) knowledge of the physicochemical and toxicological properties of modern environmentally friendly agrochemicals; (3) innovative instrumental methods of analysis, which are required to control the quality and safety of raw materials and products, to carry out agrochemical diagnostics of soils and water sources and environmental monitoring to assess the impact of agriculture on soil fertility, to conduct research activities, and to evaluate methods of processing, storage, and packaging. Laboratory specialists must have the required competence to conduct physicochemical determinations of the sample tests. The remaining specialists must know the purpose of the methods and be able to interpret the results of the determinations.

An advanced agricultural enterprise should take care of the preservation of soil fertility in its territories for many years. Therefore, soil analysis should not be performed once. On the contrary, the enterprise should monitor some indicators to assess the impact of long-term agricultural activity on soil conditions. These data are necessary to develop a digital model for the management of the physiological and biochemical processes on the farm to obtain high-quality products [8,42–45].

Thus, it is obvious that for environmentally safe functioning, farms need to interact with research laboratories. Accordingly, in the system of the agricultural sector of our country, there should be specialists from research laboratories who are proficient in the most innovative methods of chemical and physicochemical analysis concerning the objects of the agrosphere.

Specialists working with land (agronomists, soil scientists, and ecologists) should also know the methods for laboratory diagnostics of the objects of the agrosphere but at a different level than laboratory specialists. One of the main professional tasks is to carry out agrotechnical measures aimed at increasing soil fertility and productivity of cultivated crops. To solve this task, farm specialists must understand the purpose of the physical and chemical methods of analysis, make the right choice when ordering certain tests, select the samples of the objects of the agrosphere (soil, water, plants, etc.) to determine the physical and chemical indices, interpret the results of laboratory tests, assess soil fertility, and make recommendations on agrotechnical measures based on the results of the analytical determinations of the physicochemical indices of soil, water, and plants, as well as carry out the necessary calculations and carry out research activities.

To perform these labor functions, when training agrarian specialists, it is vital to pay attention to the formation of basic concepts of the newest methods of chemical and physicochemical analysis, their purpose and the interpretation of their results, and the methods of quantitative information processing. These competencies should be formed in addition to the traditional knowledge of the fundamental sections of chemistry, which is necessary for understanding the foundations of dynamic processes in nature and the technosphere, and the quantitative methods describing chemical processes. Basic chemical training is carried out in the chemical disciplines of a bachelor's degree and includes different sections such as properties of inorganic and organic substances, chemical and physicochemical phenomena, solutions, pH, Raoult's laws, osmosis, fundamentals of thermodynamics, chemical equilibrium, chemical kinetics, electrochemistry, phase equilibria, surface science, adsorption, and dispersed systems.

RSAU—MTAA carries out the master's program "Agroecological management, chemical-toxicological, microbiological analysis, and assessment of agricultural objects", a profile in the specialty "Agrochemistry and agrosoil science" where one of the basic components is chemical disciplines. In addition to this program, three more master's programs in similar fields of knowledge are being implemented in Russia: (1) MSc Chemistry of the Environment, Peoples' Friendship University of Russia (Moscow, Russia); (2) Master in Environmental Chemistry, Chemical Expertise and Environmental Security, Immanuel Kant Baltic Federal University (Kaliningrad, Russia); (3) "Soil and ecological monitoring, protection and rational use of lands", master's degree, Perm State Agro-Technological University (Perm, Russia). For such a large country, this is not enough. There are similar programs in other countries: (1) MSc in Sustainable Agriculture and Food Security, Czech University Of Life Sciences Faculty of Agrobiology, Food and Natural Resources; (2) Master in Food Safety and Quality, University of Veterinary Sciences (Brno, Czech Republic); (3) Master in Food Politics and Sustainable Development, European School of Political and Social Sciences (Lille, France); (4) MSc in Food Quality and Safety, University of Bayreuth (Bayreuth, Germany); (5) MA in Environment, Development, and Peace with Specialization in Sustainable Food Systems, University for Peace (Ciudad Colón, Costa Rica); (6) Master of Science in Food Safety and Quality Engineering, University Of Debrecen (Debrecen, Hungary); (7) Master of Science in Sustainable Agriculture and Food Security, Royal Agricultural University (Cirencester, United Kingdom); and others.

The master's program "Agroecological management, chemical-toxicological, microbiological analysis, and assessment of agricultural objects" has been used for over 10 years and is aimed at training specialists in the field of chemical, biochemical, microbiological, and physicochemical quality control of agricultural products at all stages of the technological scheme of production, storage, and processing. The other competencies of the specialists' training are to assess the quality of products in terms of the content of toxicants and macro and trace elements, considering the requirements of environmental safety and the features of the qualitative and quantitative composition, to carry out scientific work in the field of quality control and product certification. Graduates of this master's program worked successfully in the area of their specialty. Most graduates work in enterprises and research institutes, subordinate to the Ministry of Agriculture. Many of them work for different

enterprises in the departments of incoming quality control or the centers of Rosselkhoznadzor (Federal Service for Veterinary and Phytosanitary Surveillance) and Rospotrebnadzor (Federal Service for Surveillance on Consumer Rights Protection and Human Well-being).

Table 2 summarizes the information on the methods for forming the necessary chemical competencies for various specialists in the agro-industrial sector.

In addition, the Department of Chemistry of RSAU—MTAA provides further education programs such as "Biological and instrumental methods of quality control of consumer goods with the use of nanotechnological equipment and consumables from Russian manufacturers" and "Chemical aspects of organic farming". The first program is aimed at developing students' competence to carry out analytical determinations of physicochemical indices by methods of thermal and chromatographic analysis, molecular and atomic spectroscopy, electron microscopy, potentiometry, flame photometry, and chemical analysis methods. To achieve this, students acquire the corresponding knowledge (rules for sampling and preparing samples for analytical determinations; principles of the methods of thermal and chromatographic analysis, molecular and atomic spectroscopy, electron microscopy, etc.; the field of their application; the technical characteristics and operation techniques of the corresponding devices; rules for the interpretation of research results and for concluding physicochemical methods of analysis) and skills (sampling and preparing samples of agrosphere objects, raw materials, and food products for the determination of their physicochemical indices, carrying out analytical determinations on special devices, and interpreting the analytical results). The second program, "Chemical aspects of organic farming", presents a comprehensive scientific and methodological approach to the examination of an organic agricultural enterprise to confirm the quality of "organic" class products. The approach includes a comprehensive assessment of all components of the organic production system "soil–plant–products". Students gain knowledge about the methods and techniques of the necessary soil examinations and learn to interpret the results. Moreover, they draw conclusions and write down recommendations for improving soil fertility based on physicochemical index data. The program includes only those methods of fertilization and tilling that are permitted in organic farming.

Table 2. Competences based on the chemical knowledge and skills of specialists working in the field of production, processing, and quality control of agricultural products.

Competences	Skills	Knowledge	Possible Educational Programs for Competence Formation
Agronomists, soil scientists, and agricultural chemists (Soil fertility, productivity, and quality of crops)			
Conduct agrotechnical measures aimed at increasing soil fertility and productivity of cultivated crops.	Conduct sampling of agrosphere objects (soil, water, plants, etc.) for the determination of physical and chemical indices. Assess soil fertility, make recommendations on agrotechnical measures based on the results of the analytical determinations of the physical and chemical indices of soil, water, and plants. Carry out the necessary calculations. Apply fertilizers.	Knowledge of the methods of chemical and physicochemical analysis. Basic knowledge of the fundamental sections of chemistry that are necessary for understanding the foundations of dynamic processes in nature and the technosphere. Quantitative methods describing chemical processes and innovative methods of quantitative information processing.	Bachelor's disciplines: Inorganic, analytical, physical, colloid, and chemistry, physicochemical analytic methods, the chemistry of biologically active substances, chemicals for plant protection, toxicology of pesticides. Optional: methods for identifying an unknown compound.

Table 2. *Cont.*

Competences	Skills	Knowledge	Possible Educational Programs for Competence Formation
Food technologists, technologists for the processing of medicinal and essential oil raw materials, and biotechnologists (Products processing)			
Process organic products using processing methods that guarantee environmental integrity and preserve the defining qualitative characteristics of products at all the stages of the production chain.	Evaluate the introduction of planned changes in the processing technology to improve product quality. Control the technological process. Conduct sampling of raw materials and food products for the determination of physical and chemical indices at certain stages of the production process. Keep records concerning the laboratory research of raw materials and products.	Basic knowledge of the fundamental sections of chemistry that are necessary for understanding and controlling the dynamic processes in nature and the technosphere. Sampling rules for analytical determinations.	Biotechnology of food raw materials and products of plant and animal origin.
Specialists of raw material and finished product quality control laboratories and ecologists (Laboratory research)			
Carry out the analytical determination of physicochemical indices by methods of thermal and chromatographic analysis, molecular and atomic spectroscopy, electron microscopy, potentiometry, flame photometry, methods of chemical analysis, etc.	Conduct sampling and sample preparation of agrosphere objects (soil, water, plants, etc.), raw materials, and food products for the determination of physical and chemical indicators. Perform analytical determinations on devices. Interpret the results of the analytical determinations.	Rules for sampling and preparing the samples for analytical determinations. Principles of methods of thermal and chromatographic analysis, molecular and atomic spectroscopy, electron microscopy, etc., the field of their application, the technical characteristics and operation techniques of the corresponding devices. Rules for the interpretation of research results and for concluding physicochemical methods of analysis.	Master's program "Agroecological management, chemical-toxicological and microbiological analysis of agricultural objects" and further education programs.

3.5. Examples of Implementation of the Green Chemistry Principles in the Educational Process

According to the results of participation in the UI GreenMetric World University Ranking 2021, Russian State Agrarian University named after K.A. Timiryazev became one of the 300 "greenest" universities in the world. Timiryazev Academy is in the top ten among Russian universities. The maximum scores were in the group of indicators "Education and Research". We propose to consider examples of the inclusion of the principles of green chemistry in the content of the educational process of this agrarian university.

Reduction of production waste to the minimum possible. Students should be taught that they should strive for waste-free agricultural production. For this purpose, the Department of Chemistry of the RSAU—MTAA has been researching an elaboration method for agricultural waste processing. For example, with the help of students, research has been conducted on the processing of flax and hemp straw. The students developed soil formulations for growing seedlings with the addition of flax straw and hemp. In addition, formulations of building materials (tiles and bricks) with the addition of crushed hemp straw were developed (Figure 1).

Figure 1. The development of recipes for building materials from hemp waste is underway.

If possible, substances with minimal toxicity are used by people and the environment. Together with the students, scholars have systematized the information on the physicochemical and toxicological properties of the active substances of preparations approved for use in organic agriculture. The mechanisms of action of the active substances of these drugs were considered.

The environmental safety requirements for the use of mineral fertilizers are constantly increasing. Phosphoric acid purified using organic solvents is often used to obtain phosphate fertilizers. At the Department of Chemistry, cooperating with our students, we researched the most effective method for the purification of phosphoric acid for the subsequent synthesis of phosphate fertilizers. Based on this, a magnesium ammonium phosphate ($MgNH_4PO_4$) fertilizer was synthesized.

Energy costs should be re-evaluated in terms of savings and environmental impacts and kept to a minimum. Efficient use and heat recovery are some of the most important tasks that humanity has to face today, with both environmental and economic prospects. Therefore, it is difficult to re-evaluate the importance of this issue, especially in the agro-industrial sector. At the Department of Chemistry of our university, we determine the thermodynamic characteristics of biological processes. For this purpose, the department has elaborated a thermo-analytical complex procedure that allows determination of the thermodynamic characteristics of each starting substance and reaction product, quantifying the thermochemical effect of the process and elaborating recommendations for reducing the energy costs of certain biochemical reactions. The research is carried out jointly with our students, who conduct their own projects and are co-authors of scientific articles [45].

The educational and research activities of students are constantly interacting [38,46].

In the basic courses, when studying the section "Thermochemistry", we include information about the principles of heat management and information about alternative renewable energy sources. This is very important for agriculture since the waste from this industry can be used as an energy source. Cellulose and other types of biomasses, as well s vegetable oils, are an incomplete list of raw materials suitable for these purposes.

The use of catalytic systems and processes. We develop and research or test biochemical process catalysts and plant growth regulators by order of other organizations. The active substances of these drugs affect the dynamics of plant growth and development and the accumulation of certain substances by the plant. For industrial crops such as flax, the purpose of using these preparations is to reduce the amount of lignin and increase the fiber content [47].

Analytical control methods must be applied with sufficient regularity and accuracy. Students learn methods for chemical and instrumental analyses of the corresponding undergraduate disciplines. We have published several handbooks and textbooks on the analysis methods used in agricultural production facilities. In addition, the master's program "Agroecological management, chemical-toxicological, microbiological analysis, and assessment of agricultural objects" described above has been in great demand for more than a decade. An-

alytical instruments and equipment allow students to familiarize themselves with the most innovative methods of analysis: scanning electron microscopy in combination with energy dispersion analysis, near-infrared spectroscopy, thermogravimetry, and other physico-chemical methods that allow the rapid analysis of the quality of agricultural commodities (Figure 2).

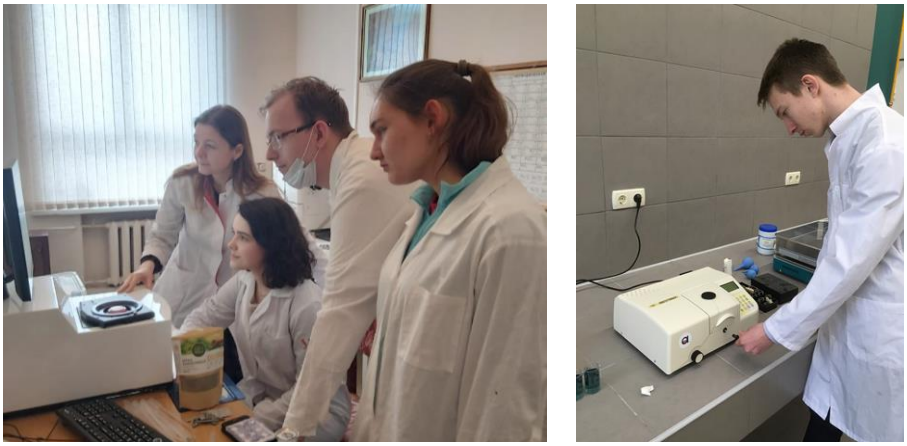

Figure 2. Analytical research in the project activities of students.

Express methods are very much in demand when analyzing agricultural objects. With the participation of students, work was carried out, as a result of which a blister-colorimetric method for determining phosphate ions was developed. The determination is carried out in a blister cell containing a mixture of dry reagents in the form of a mixture. This method allows semi-quantitative determination of the phosphorus in various objects without preparation of reagent solutions using a dry mixture packed in a vial or blister. This method can be used to control phosphorus consumption by plants, which in turn makes it possible to rationally introduce nutrients in the form of additional fertilizers [48].

To assess the effectiveness of the work carried out on the formation of students' competencies based on the principles of green chemistry, an experimental study was conducted.

The control group consisted of graduates of an agricultural university, where purposeful work on the introduction of the principles of green chemistry into the educational process was not carried out (46 people).

The experimental group consisted of graduates of the K.A. Timiryazev Russian State Agricultural Academy, whose training was based on the principles of green chemistry (51 people).

Respondents were offered questions and tasks aimed at monitoring the formation of competencies based on the principles of green chemistry.

Table 3 presents the results of the measurements of the level of competence in the field of green chemistry in the control and experimental groups.

Table 3. Results of measurements of the level of competence in the field of green chemistry in the control and experimental groups.

Competence Level	Control Group, Frequency/%	Experimental Group, Frequency/%
Low	38/82.6	27/53
Average	7/15.2	14/27.4
High	1/2.2	10/19.6

A visual description of the results of measuring the level of competence in the field of green chemistry principles is presented in the histogram (Figure 3).

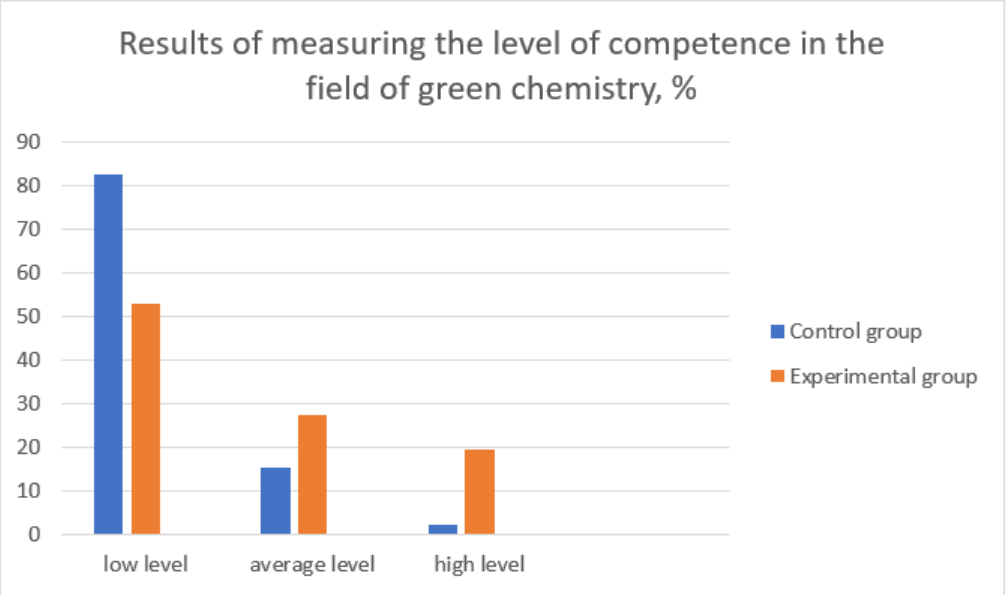

Figure 3. Results of measuring the level of competence in the field of green chemistry principles.

As a statistical criterion on the significance of differences in the level of competence in green chemistry in the control and experimental groups, the χ^2 criterion was used.

The empirical value of χ^2 for the compared samples is 9.1, which is higher than the critical value of $\chi^2_{0.05} = 5.99$, which allows us to conclude that the differences in the compared samples are reliable. This allows us to conclude about the effectiveness of the applied pedagogical system for the formation of students' philosophy of sustainable development based on competence in the field of green chemistry.

4. Discussion

Our study considers in detail chemical competencies expected by the modern agro-industrial complex of Russia for various groups of agricultural specialists. We showed the ways of modernization of the system of teaching chemical disciplines in agricultural universities in order to make it possible to form these competencies. This is a continuation of our previous studies presented in the works [8,18,35]. We plan to continue working in this direction, studying the long-term results of the ongoing modernization.

Chemical training in Russian agrarian universities developed according to the requirements of the agrarian industry in each specific historical period. In the 19th century, the teaching of chemistry was of a classical academic nature. Students acquired fundamental chemical knowledge, and the agrarian specialization of the studied disciplines was minimal. In the twentieth century, the education system was focused on teaching a large number of students and aimed at solving the problems of intensive farming using chemicalization. The resulting environmental problems have resulted in several new tasks for agricultural specialists. The main advantages of the chemical training system for agrarian students in Russia are the fundamental nature of knowledge, the widespread use of chemical experiments in training, and the involvement of trainees in research work under the guidance of the teaching staff.

To overcome the problems associated with the chemicalization of agriculture and intensive use of land resources, the development of environmentally oriented agricultural production and the education of specialists in this industry play a great role. In particular, the chemical competence of specialists of the agro-industrial complex should also be focused on the concept of sustainable development and green technologies.

Modern agriculture needs new, environmentally friendly technologies, which in turn necessitates scientific research and development in this area.

The change in the educational concept of chemical training of a modern agrarian should be systemic in nature and include the following components: ideological (training based on the concept of sustainable development), cognitive (knowledge of green chemistry based on the latest scientific achievements), and activity (experience in practical and research activities to implement the principles of sustainable development in agricultural production).

To achieve this, the university carried out work in several areas. Scientific research was carried out in the field of green chemistry and ecological agriculture: the development of new methods for the use and processing of agricultural waste; the study of sorption properties of soil and plant biomass; the synthesis of substances and the development of new methods of purification of drugs in accordance with the principles of green chemistry; the development of new methods of rapid analysis of substances that can be used for environmental monitoring and other research. During the educational process, attention was paid to the formation of an appropriate worldview and students' understanding of the value of nature. When building basic courses, the content included information about the principles of green chemistry and new research, including those conducted at our university. Project training and joint work on research with teachers allowed students to gain practical and research experience necessary for the formation of their ability and readiness to cope with professional tasks in the future, guided by the principles of sustainable development and methods of green chemistry. The modernization of the system of chemical training of future farmers is associated with overcoming certain difficulties: it is necessary to seek temporary, material, and intellectual resources. However, the purpose for which it is carried out is undoubtedly worth the effort.

We believe that it would be premature to completely exclude the intensive trajectory of agricultural development at present. However, the search and implementation of cost-effective environmental technologies is already objectively necessary. The ratio of applied technologies should shift toward environmentally oriented ones every year.

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References

1. Glackin, M.; King, H. Taking stock of environmental education policy in England—The what, the where and the why. *Environ. Educ. Res.* **2020**, *26*, 305–323. [CrossRef]
2. Payne, P. The politics of environmental education. Critical inquiry and education for sustainable development. *J. Environ. Educ.* **2016**, *47*, 69–76. [CrossRef]
3. Reid, A. Environmental Education and Sustainable Development Policy Research: Sleep and Awakening. *J. Philos. Educ.* **2020**, *54*, 838–865. [CrossRef]
4. Rickinson, M.; Mackenzie, M. Research and Policy Relationships in Environmental and Sustainable Education. *Environ. Educ. Res.* **2021**, *27*, 465–479. [CrossRef]
5. Bylund, L.; Hellberg, S.; Knutsson, B. We must urgently learn to live differently': The biopolitics of ESD for 2030. *Environ. Educ. Res.* **2021**, *28*, 40–55. [CrossRef]
6. Mulder, M.; Kupper, H. The Future of Agricultural Education: The Case of the Netherlands. *J. Agric. Educ. Ext.* **2006**, *12*, 127–139. [CrossRef]
7. Liberloo, M.; Bijttebier, J.; Lacour, E.; Stilmant, D.; Marchand, F. Reflexive monitoring in action: Setting up a monitoring system for learning effectiveness in agroecological farm innovation. *J. Agric. Educ. Ext.* **2021**, *28*, 231–250. [CrossRef]

8. Grigoryeva, M.V. Chemical Preparation of Modern Agrarians: Studying the Opinion of Working Specialists [Химическая подготовка современного агрария: изучение мнения работающих специалистов]. *Int. Sci. J.* **2021**, *4*, 68–76. (In Russian)
9. Koutsouris, A. Innovating towards Sustainable Agriculture: A Greek Case Study. *J. Agric. Educ. Ext.* **2008**, *14*, 203–215. [CrossRef]
10. Wiek, A.; Withycombe, L.; Redman, C.L. Key Competencies in Sustainable Development: A Reference Framework for Academic Programming. *Sustain. Dev. Sci.* **2011**, *6*, 203–218. [CrossRef]
11. Lambrechts, W.; Liedekerke, L.V.; Petegem, P.V. Higher education for sustainable development in Flanders: Balancing between normative and transformative approaches. *Environ. Educ. Res.* **2018**, *24*, 1284–1300. [CrossRef]
12. MacGregor, S. Sustainability through Vicarious Learning: Reframing Consumer Education. In *Social Learning Towards a Sustainable World*; Wageningen Academic Publishers: Wageningen, The Netherlands, 2007; Volume 19.
13. Vermunt, D.A.; Wojtynia, N.; Hekkert, M.P.; Dijk, J.V.; Verburg, R.; Verweij, P.A.; Wassen, M.; Runhaar, H. Five mechanisms blocking the transition towards "nature-inclusive" agriculture: A systemic analysis of Dutch dairy farming. *Agric. Syst.* **2022**, *195*, 103280. [CrossRef]
14. Dorin, B. Theory, Practice and Challenges of Agroecology in India. *Int. J. Agric. Sustain.* **2021**, *20*, 153–167. [CrossRef]
15. Emendu, N.B. The role of chemistry education in national development. *Int. J. Eng. Sci.* **2014**, *3*, 12–17.
16. Fanzo, J.; Remans, R.; Sanchez, P. *The Role of Chemistry in Addressing Hunger and Food Security the Chemical Element: Chemistry's Contribution to Our Global Future*; Wiley-VCH Verlag GmbH and Co. KGaA: Weinheim, Germany, 2011; pp. 71–97.
17. Daluba, N.E. Effect of demonstration method of teaching on students' achievement in agricultural science. *World J. Educ.* **2013**, *3*, 1–7.
18. Grigoryeva, M.V.; Belopukhov, S.L. Chemical disciplines in the system "bachelor's–master's–post-graduate program of an agrarian university" [Химические дисциплины в системе "бакалавриат-магистратура-аспирантура аграрного вуза"]. *Hist. Pedagog. Nat. Sci.* **2020**, *2*, 5–8. (In Russian) [CrossRef]
19. Charlesworth, P.; Vician, C. Leveraging technology for chemical sciences education: An early assessment of WebCT usage in first-year chemistry courses. *J. Chem. Educ.* **2003**, *80*, 1333–1337.
20. Morgil, İ.; Erokten, S.; Yavuz, S.; Ozyalçın Oskay, O. Computerized applications on complexation in chemical education. *Turk. Online J. Educ. Technol. TOJET* **2004**, *3*, 3–8.
21. Zuin, V.; Mammino, L. (Eds.) *Worldwide Trends in Green Chemistry Education*; The Royal Society of Chemistry: London, UK, 2015. [CrossRef]
22. Armstrong, L.B.; Rivas, M.C.; Douskey, M.C.; Baranger, A.M. Teaching students the complexity of green chemistry and assessing growth in attitudes and understanding. *Curr. Opin. Green Sustain. Chem.* **2018**, *13*, 61–67. [CrossRef]
23. Dicks, A.P.; D'eon, J.C.; Morra, B.; Chisu, C.K.; Quinlan, K.B.; Cannon, A.S. A systems thinking department: Fostering a culture of green chemistry practice among students. *J. Chem. Educ.* **2019**, *96*, 2836–2844. [CrossRef]
24. Hurst, G.A. Systems thinking approaches for international green chemistry education. *Curr. Opin. Green Sustain. Chem.* **2020**, *21*, 93–97. [CrossRef]
25. Chen, T.-L.; Kim, H.; Pan, S.Y.; Tseng, P.-C.; Lin, Y.-P.; Chiang, P.-C. Implementation of green chemistry principles in circular economy system towards sustainable development goals: Challenges and perspectives. *Sci. Total Environ.* **2020**, *716*, 136998. [CrossRef]
26. Tarasova, N.; Lokteva, E.; Lunin, V. Green Chemistry Education in Russia. In *Worldwide Trends in Green Chemistry Education*; The Royal Society of Chemistry: London, UK, 2015; Chapter 12; pp. 213–247. Available online: https://pubs.rsc.org/en/content/chapter/bk9781849739498-00213/978-1-84973-949-8/Unauth (accessed on 15 September 2021).
27. Lunin, V.V.; Lokteva, E.S.; Golubina, E.V. Innovative educational programs in the field of chemistry. In *Scientific and Educational Center "Chemistry in the Light of Sustainable Development—Green Chemistry"*; [Инновационные образовательные программы в области химии. Научно-образовательный центр. "Химия в интересах устойчивого развития—зеленая химия"]; Moscow State University Press: Moscow, Russia, 2007; 117p. (In Russian)
28. Kustov, L.M.; Beletskaya, I.P. Green Chemistry—A new way of thinking. [Green Chemistry—новое мышление]. *Russ. Chem. J.* **2004**, *6*, 3–12. (In Russian)
29. Lokteva, E. How to Motivate Students to Use Green Chemistry Approaches in Everyday Research Work: Lomonosov Moscow State University, Russia. *Curr. Opin. Green Sustain. Chem.* **2018**, *13*, 81–85. Available online: https://www.sciencedirect.com/science/article/pii/S2452223618300270 (accessed on 23 May 2022). [CrossRef]
30. Grain Market Overview. 2019. International Grain Council. Available online: https://www.igc.int/downloads/gmrsummary/gmrsummr.pdf (accessed on 23 May 2022).
31. Stepanova, L.P.; Tsyganok, E.N.; Tikhoikina, I.M. *Ecological Problems of Agriculture*; [Экологические проблемы земледелия]; Bulletin of the Orel State Agrarian University: Orel City, Russia, 2012. Available online: https://cyberleninka.ru/article/n/ekologicheskie-problemy-zemledeliya (accessed on 23 May 2022).
32. Environmental Problems in Agriculture and Their Causes. 2003. Available online: https://musorniy.ru/ekologicheskie-problemy-v-selskom-hozyaystve/ (accessed on 23 May 2022).
33. The Emergence of Risks Related to the Environment and New Technologies 2004. Available online: https://www.fao.org/3/j3255r/j3255r00.htm (accessed on 23 May 2022).
34. Rulyov, A. Chemophilia vs chemophobia [Хемофилия против хемофобии]. *Sci. Life* **2020**, *6*, 24–32. (In Russian)

35. Grigoryeva, M.V.; Belopukhov, S.L. Aspects of the chemical training of personnel for organic farming [Аспекты химической подготовки кадров для органического земледелия]. *Prof. Educ. Present-Day World* **2021**, *11*, 154–165. (In Russian) [CrossRef]
36. Grigoryeva, M.; Belopukhov, S.; Dmitrevskaya, I.; Seregina, I. Green Chemistry as the Basis for Development of the Philosophy of Sustainable Education in an Agricultural University. In Proceedings of the Second Conference on Sustainable Development: Industrial Future of Territories (IFT 2021), Yekaterinburg, Russia, 24 September 2021. [CrossRef]
37. Garina, E.P.; Shushkina, N.A. Green Economy in Agriculture of the Russian Federation. Aeconomics: Economics and Agriculture 2015. Available online: https://cyberleninka.ru/article/n/zelyonaya-ekonomika-v-selskom-hozyaystve-rossiyskoy-federatsii (accessed on 12 November 2021).
38. Grigoryeva, M.V.; Bagnavets, N.L.; Belopukhov, S.L. Students' academic and research activity as a component of the continuity system between bachelor's and master's programs [Учебно-исследовательская работа студентов как компонент системы преемственности между бакалавриатом и магистратурой]. *Hist. Pedagog. Nat. Sci.* **2021**, *5–10*, 42–48. (In Russian) [CrossRef]
39. Anastas, P.T.; Warner, J.C. *Green Chemistry: Theory and Practice*; Oxford University Press: Oxford, UK, 2000.
40. Anastas, P.; Bartlett, L.B.; Kirchhoff, M.M.; Williamson, T.C. The Role of Catalysis in the Design, Development, and Implementation of Green Chemistry. *Catal. Today* **2000**, *55*, 11–22. [CrossRef]
41. Anastas, P. Meeting the challenges to sustainability through green chemistry. *Green Chem.* **2003**, *5*, 29–34.
42. Belopukhov, S.L.; Baibekov, R.F.; Savich, V.I.; Gukalov, V.V. Agroecological evaluation of Crimean chernozem when cultivating lavender and using organic farming technologies for optimizing the situation. [Агроэкологическая оценка черноземов Крыма под культурой лаванды и использование приемов органического земледелия для оптимизации обстановки]. *Agrar. Russ.* **2021**, *2*, 42–48. (In Russian)
43. Belopukhov, S.L.; Grigoryeva, M.V.; Dmitrevskaya, I.I.; Zhevnerov, A.V. Agroecological approach to quality assessment of organic aromatic products. In Proceedings of the International Conference "Ensuring Food Security in the Context of the COVID-19 Pandemic", Doushanbe, Republic of Tadjikistan, 29–31 March 2021. [CrossRef]
44. Grigoryeva, M.V.; Belopukhov, S.L.; Dmitrevskaya, I.I.; Bagnavets, N.L. Pedagogical conditions in the formation of competencies on determining the content of pesticides in agricultural production. [Педагогические условия формирования компетенции по определению содержания пестицидов в сельскохозяйственной продукции]. *Int. Sci. J.* **2021**, *3*, 112–124. (In Russian) [CrossRef]
45. Belopukhov, S.L.; Starykh, S.E.; Kupriyanov, A.N.; Grigoryeva, M.V. Research on the qualitative composition of humus acids of soddy-podzolic soil using thermal analysis. [Исследование качественного состава гумусовых кислот дерново-подзолистой почвы методом термического анализа]. *Environ. Eng.* **2020**, *3*, 36–45. (In Russian) [CrossRef]
46. Grigoryeva, M.V.; Bagnavets, N.L.; Belopukhov, S.L. Project works when teaching the master's program "Chemical-toxicological analysis of the objects of the agrosphere". [Проектные работы при обучении по магистерской программе "Химико-токсикологический анализ объектов агросферы"]. *Agroengineering* **2020**, *2*, 64–69. (In Russian) [CrossRef]
47. Dmitrevskaya, I.I.; Belopukhov, S.L.; Bagnavets, N.L.; Grigoryeva, M.V. Applying the growth stimulator of plant origin Rafitur when cultivating flax. [Применение стимулятора роста растительного происхождения Рафитур для выращивания льна]. *Agrochem. J.* **2020**, *3*, 53–56. (In Russian) [CrossRef]
48. Bagnavets, N.; Zhevnerov, A.; Grigoryeva, M.; Pshenichkina, T. Influence of phosphorus fertilizers of various composition on the yield of tomato crops and control of their consumption by plants. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, *937*, 022131. [CrossRef]

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The Impact of Student-Teacher Policy Perception on Employment Intentions in Rural Schools for Educational Sustainable Development Based on Push–Pull Theory: An Empirical Study from China

Siyu Chen [1,*], Ran Wang [2], Tingting Wang [1] and Wenxian Zhou [1]

[1] School of Education, South China Normal University, Guangzhou 510000, China; wangtt@m.scnu.edu.cn (T.W.); zhouwenxian@m.scnu.edu.cn (W.Z.)
[2] Longhua Second Primary School, Shenzhen 518000, China; wangr@m.scnu.edu.cn
* Correspondence: chensiyu@m.scnu.edu.cn; Tel.: +86-136-3245-9298

Abstract: Governments and professional organizations around the world have realized that successful recruitment and retention policies are vital to address the shortage of teachers in rural and remote areas. To the best of our knowledge, despite extensive advocacy of policies and discussions pertaining to their implications, an academic investigation into how student teachers perceive the policies and how their policy perception influences rural employment intentions has rarely been performed. Herein, this study is devoted to investigating the impact of policy perception on student-teacher rural employment intentions. In this study, the participants consist of undergraduate and postgraduate students at Chinese universities who specialize in preparing teachers of all disciplines. A questionnaire survey and quantitative analysis based on commercially available software Questionnaire Star, SPSS 26.0, Amos 26.0 and RMediation package were performed in data acquisition and analysis. It was found that student-teacher perception of the supporting policy Rural Revitalization Strategy was a little below average. High policy perception leads to an increase in the intentions of student teachers to seek employment in rural areas, and social support and positive job perception mediate the linkage between policy perception and rural employment intentions. It was also found that a difference in academic qualifications, census registration, and unpaid teaching satisfaction exists in the intentions to teach in rural schools. Such effects can be explained by the push–pull theory. Finally, this study provides recommendations for governments, universities, rural schools, and families.

Keywords: educational sustainable development; job perception; policy perception; push–pull theory; quantitative research; rural employment intentions; social support; student-teachers

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1. Introduction

Teachers are the most crucial school-related factor impacting the academic achievements of students and educational sustainable development (ESD) [1–3]. However, due to geographical isolation, limited access to professional development activities, low salary, and engagement in teaching a variety of subjects [4], large rural areas in many countries are experiencing a decrease in the number of teachers and are facing a serious challenge of recruiting and retaining qualified teachers [5], which has impeded sustainable development of the whole society. To curb this problem and to prevent the deterioration of the situation, many countries and universities have introduced relevant policies and spent a substantial amount of resources to train, recruit, and retain qualified teachers, especially for rural areas [6–8], such as the National Outstanding Teacher in Disadvantaged School Program launched by Australia [9] and the Rural Revitalization Strategy (RRS) introduced by China [10].

The RRS was introduced in the 19th National Congress of the Communist Party of China in 2017, which was a critical decision to enhance sustainable rural development [11].

The key to rural revitalization is to win the fight against poverty, which is inseparable from a strong support of professional and technical talents cultivated through education. The RRS has emphasized the significance of education in poverty alleviation and taken active steps to promote sustainable rural education [12]. First, it has prioritized the ESD and the implementation of policies in rural areas. Second, to encourage and attract excellent university graduates and in-service teachers to apply for jobs in rural schools, a series of subprojects was also introduced, namely Plans of Talents Support, San Zhi Yi Fu (Taking Community-level Posts in Education, Agriculture, Health Care, and Poverty Relief) and Special-Posts Teacher Project. Third, to eliminate the apprehensions of teachers with respect to the inaccessibility of and isolation from cities, the RRS emphasizes building infrastructure and developing social security system in rural areas, including the implementation of the Digital Village Strategy, popularizing telemedicine and distance education, and fortifying the construction of primary medical care.

Supporting policies like the RRS have been proven to be effective to alleviate rural teacher shortages and to speed up sustainable and coordinated progress of rural and urban areas over time [13]. However, the output of any policy is affected by one or more problems in the process of implementation and may not always meet the expectations and objectives of the policymakers [14]. For example, some student teachers leave after teaching for a short period of time. This has a negative impact on the local teachers, and hence the rural schools have to face the burden [15]. Previous studies on these issues have focused on an analysis of policy contents [11], case studies of policy implementation [16], teacher development against the background of the policies [17], strategies to execute policies [18], indicators to evaluate effects [19,20], and constraints of the policies [21]. Previous research has found that college student policy perception had a significant positive effect on their job search [22,23], but the influencing mechanism is yet to be explored. In addition, issues related to policy perception, social support, job perception, or intentions have been studied in some other disciplines, but there are few existing studies that fully demonstrated their relationship. In recent years, China has enacted a series of policies to support the recruitment and retention of rural teachers and produced some effects; therefore, it is an appropriate country for investigation and for providing experience for other countries to foster ESD.

The general question of this study is thus how exactly Chinese student-teacher perception of supporting policies (RRS in particular) influence intentions to teach in rural schools. In order to answer this question of how (the influencing mechanism), there needs to be an analysis of what (the status quo of Chinese student-teacher policy perception and rural employment intentions) and why (factors that influence Chinese student-teacher rural employment intentions). For that reason, this study focuses on three questions: (I) What is the Chinese student-teacher perception of the supporting policy, the RRS, and intentions to teach in rural schools? (II) What are the push and pull factors that influence Chinese student-teacher intentions to teach in rural schools? (III) How does policy perception affect rural employment intentions? This study aims to fill the literature gap with research findings and provide governments, universities, schools, and families with empirical evidence to enhance development for sustainability.

The following sections of the article are arranged as follows: In Section 2, we reviewed the latest research literature on rural employment of teachers, policy perception, social support, and job perception. This is followed by a discussion of the samples, methods, and details pertaining to the study data in Section 3. The quantitative analysis of the data was performed using SPSS 26.0 and Amos 26.0, and the influence of student-teacher perception of the policy (RRS) on their employment intention in rural China is shown in Section 4. Discussions about the results, limitations, implications, and conclusions are presented in Sections 5 and 6.

2. Conceptual Framework

The present study regards student-teacher rural employment intention as a kind of migration. In migration studies, the push–pull (PP) theory is the dominant paradigm [24];

thus, this framework is appropriate to explore student-teacher decisions to teach in rural areas for ESD with a few slight modifications. The PP theory holds that people's migration from one place to another is influenced by PP factors [25]. Push factors refer to negative factors that force people to leave their origin, while pull factors refer to positive factors that draw people to a destination [25]. Specifically, in the current research, negative or low policy perception, a lack of social support, and negative job perception were proposed as push effects, while positive or high policy perception, proper social support, and positive job perception were proposed as pull effects. Although policies and rural employment literature have revealed some insightful observations on rural schools and teacher development, previous studies that adequately demonstrate student-teachers moving to teach in rural areas are rare. Thus, quantitatively exploring factors and their effects on student-teacher determination to teach in rural schools by adopting the PP theory has both theoretical and practical values.

2.1. Policy Perception and Rural Employment Intentions

It has been perceived that individuals seek out and respond to impulse-related stimuli. Policy perception is a psychosocial condition in which people gain information about their knowledge of policy choices that support targeted behaviors and assess whether a policy system is aiding in the achievement of policy goals [26]. Policy perception is also a description of how policies affect people's evaluation, identification, and experience of future policy changes [27]. The perception of the pros and cons of the policies is likely to make individuals support or oppose them, make judgments, and adopt certain behaviors [28]. Research showed that students who were "very familiar with the free student-teachers policy" had a higher intention of working in rural areas [29]. Specifically, individuals with higher policy perception are able to evaluate objectively and reasonably whether the fulfillment of their demands of employment is facilitated by the support provided by the policy, influence their employment plans and choices, thereby generating a stronger willingness to work in rural areas [27].

"Intention" refers to people's mental state that guides them to take action and predicts their future behaviors [30]. Employment intention is the mental state that guides people to adopt specific job-hunting behaviors [31]. It is generated by the continuous stimulation of various employment motivations and satisfaction of employment needs [32]. It is related to the individuals' cultural background, personalities, abilities, life experiences, characteristics of the occupation, and social recognition [33]. Extant studies on employing university graduates in rural schools have revealed that rural areas are facing the serious challenge of a low intention of teachers to work in rural schools and of particularly high attrition rates of rural teachers [11,34]. About 33% of teachers quit their job within the first three years [35]. Although the correlation between perception and employment intentions has been tested before, what is not yet clear is the impact of student-teacher perception of incentive policies (such as RRS) on intentions to teach in rural schools through a quantitative analysis. As per our knowledge based on the available literature, the following assumptions were proposed:

Hypothesis 1 (H1). *Chinese student teachers have a relatively low perception of the supporting policy RRS.*

Hypothesis 2 (H2). *Chinese student-teacher perception of the supporting policy RRS has a positive effect on their intentions to teach in rural schools.*

Hypothesis 3 (H3). *Chinese student-teacher intentions to teach in rural schools are different depending on genders, family types, high school elective courses, academic qualifications, census registration, and unpaid teaching satisfaction.*

2.2. Social Support

Social support mainly refers to people's feelings pertaining to respect, care, resources, and help provided by social groups they belong to [36] and by important others, such as family members, relatives, peers, colleagues, and neighbors [37]. According to Werner et al. [38], the policy perception of graduates influences the policy perception of their stakeholders. In turn, stakeholder recognition and support affect the job choice of the graduates [39]. However, there is little evidence for the relationship between social support and rural employment intentions of student teachers. Thus, this study investigated how support from important others (parents, classmates, and friends) influences student-teacher intentions to teach in rural schools. Another assumption was proposed as follows:

Hypothesis 4 (H4). *Social support that Chinese student-teachers receive has a positive effect on their employment intentions, and it mediates the relationship between student-teacher perception of RRS and intentions to teach in rural areas.*

2.3. Job Perception

A person's job perception is the result of higher-order cognitive information processing reflecting the psychological impact of a job event on him or her. Furthermore, this higher-order processing is influenced by his or her individual characteristics as well as his or her job-related experiences [40]. Previous studies have found that a positive relationship exists between job perception and employment intention. The more positive the job perception is, the higher the employment intention will be [41]. However, little attention has been paid to the special cohort of student-teachers, their perception of rural teaching, and its impact on rural employment intentions. According to the PP theory, this study classified student-teacher perception of working and teaching in rural schools as positive and negative [42]. The former refers to student-teacher perception of professional development, teaching environment, and promotion opportunities if they work in rural communities, attracting graduates to become rural teachers. The latter refers to student-teacher perception of pressure and the cost of teaching in rural areas, pushing graduates away from rural schools. Based on the literature, we proposed that job perception influenced rural employment intentions, and it was the mediating variable between perception of RRS and employment intentions in rural schools. The following assumptions were made:

Hypothesis 5a (H5a). *Chinese student-teacher positive job perception increases their employment intentions to teach in rural areas, and it mediates the relationship between the perception of RRS and intentions to teach in rural schools.*

Hypothesis 5b (H5b). *Chinese student-teacher negative job perception decreases their employment intentions to teach in rural areas, and it mediates the relationship between the perception of RRS and intentions to teach in rural schools.*

The theoretical model of this study is depicted in Figure 1.

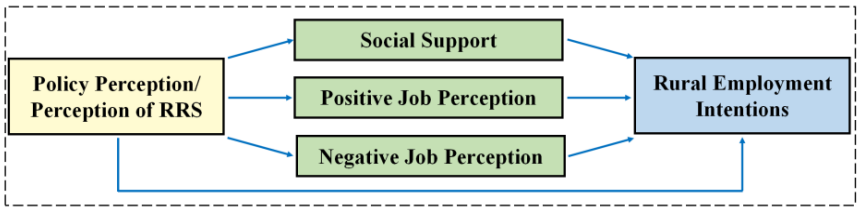

Figure 1. Theoretical framework.

3. Research Design

The major objective of this study was to assess the effects of Chinese student-teacher policy perception on their rural teaching intentions. Thus, quantitative research was

adopted, which collected information from student-teachers using a random sampling method and giving out online questionnaires. Data were analyzed through descriptive and inferential analysis aiming at data cleaning, theoretical model testing, and examining multiple effects. Results are presented in numerical form and carefully understood to predict student-teacher intentions to work in rural schools accordingly.

3.1. Data Collection and Analysis

Adapted from the valid questionnaire developed by Liu [43], the questionnaire used in this study after pretest contained six latent variables, including personal information, previous experience teaching in rural schools, perception of RRS (i.e., policy perception), social support from parents, classmates, and friends, perception of teaching in rural schools (i.e., job perception), and intentions to teach in rural schools (i.e., rural employment intentions). All participants were asked to fill in the questionnaire anonymously and thanked for their answers. Confidentiality of their opinion was protected. The questionnaire was used to collect data, and SPSS 26.0, AMOS 26.0 and RMediation package were used for the quantitative data analysis.

3.2. Sampling

Random sampling was adopted to select student-teacher participants from Chinese universities who excel in pre-service and in-service teacher education. A popular professional and paid online application Questionnaire Star was used to distribute and collect the questionnaires. With the help of several university teachers and students, the QR code and link to our questionnaire were sent to student teachers in their universities and colleges. A total of 676 questionnaires were distributed, and 675 were returned, with a recovery rate of 99.8%. As shown in Table 1, the participants included 101 males and 574 females, which reflected the unbalanced gender ratio in the education major. Among them, 175 came from one-child families. A total of 332 participants had selected science and engineering in high school, while 343 had chosen liberal arts. There were 504 undergraduates and 171 graduate students. A total of 292 participants came from urban areas, and 383 came from rural areas.

Table 1. Demographic characteristics of the sample.

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Gender			Year		
Male	101	15.0%	Freshman	129	19.1%
Female	574	85.0%	Sophomore	117	17.3%
One-child family			Junior	152	22.5%
Yes	175	25.9%	Senior	65	9.60%
No	500	74.1%	First-year graduate	74	11.0%
High school elective courses			Second-year graduate	68	10.1%
Science	332	49.2%	Third-year graduate	26	3.90%
Literature and history	343	50.8%	Others	44	6.50%
Academic qualifications			Census registration		
Undergraduate	504	74.7%	Urban	292	43.3%
Graduate	171	25.3%	Rural	383	56.7%

3.3. Reliability

A reliability analysis was used to examine the stability of the collected data, and conclusions were drawn from the questionnaire [44]. Cronbach's alpha (α) is a common indicator of reliability. As shown in Table 2, α of dimensions of social support, positive job perception, and negative job perception were 0.729, 0.851, and 0.671, respectively, and α of the total questionnaire was 0.729. All were greater than 0.65, indicating that the questionnaire was reliable [45].

Table 2. Results of reliability analysis.

Variable	Dimension	α	Variable	Dimension	α	Variable	Dimension	α
Social support	Family Support Classmate Support	0.851	Positive job perception	Career Development Work Environment	0.671	Negative job perception	Work Pressure Cost of Living	0.643
	Friend Support			Promotion Opportunities		Total α		0.729

3.4. Validity

Validity refers to the degree to which the results reflect what is being examined, and it is ascertained through confirmatory factor analysis (CFA) [44]. Before that, exploratory factor analysis (EFA) of the questionnaire was carried out using SPSS 26.0 to determine whether the data were suitable for CFA. As shown in Table 3, the KMO value of the data was 0.734 (> 0.70), and the *p*-value was less than 0.001, which revealed that the data passed the Bartlett's Spherical Test and were suitable for factor analysis [46].

Table 3. Results of validity analysis.

KMO Value	Bartlett's Spherical Test		
	Approximate Chi-Square	Degree of Freedom	Significance
0.734	1753.266	28	<0.001

Second, CFA was conducted using AMOS 26.0 software. Using the criteria proposed by Thakkar (2020) [44], this study assessed model fit by examining the following fit indicators: Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Standardized Residual Mean Root (SRMR), Normed Fit Index (NFI), Tucker–Lewis Index (TLI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Chi-square/Degree of Freedom (CIMN/DF), and Parsimonious Normed Fit Index (PNFI). Their values represented a good fit for the model (Table 4).

Table 4. Evaluation of Model Fit.

Model Fit Indices	Recommended Value	Actual Values (Modified)
GFI	>0.90	0.986
AGFI	>0.90	0.968
RMSEA	<0.08, good; <0.05, excellent	0.047
SRMR	<0.05	0.035
NFI	>0.90	0.978
TLI	>0.90	0.977
CFI	>0.90	0.987
IFI	>0.90	0.987
CIMN/DF	1–3	2.496
PNFI	>0.50	0.559

Third, Table 5 depicts the Factor Loading (FL) value, Composite Reliability (CR) value and Average Variance Extracted (AVE) value of three variables and their corresponding items. The CR value of the three variables was greater than 0.80 [47]. In addition, except for the working cost, the FL values of family support, classmate support, friend support, professional development, working environment, promotion opportunities, and working pressure were 0.674, 0.903, 0.881, 0.686, 0.838, 0.724, and 0.973, respectively, being greater than 0.50 [48].

Table 5. FL, CR, and AVE.

Variable	Dimension	FL	CR	AVE
Social support	①Family Support	0.674 ***	0.864	0.682
	②Classmate Support	0.903 ***		
	③Friend Support	0.881 ***		
Positive job perception	①Career Development	0.686 ***	0.795	0.566
	②Working Environment	0.838 ***		
	③Promotion Opportunities	0.724 ***		
Negative job perception	①Work Pressure	0.973 ***	0.724	0.593
	② Cost of Living	0.489 *		

Note: ***: $p \leq 0.001$; *: $p \leq 0.05$.

Fourth, Table 6 shows the correlation coefficient matrix of the factors. Discriminant Validity (DV) refers to the fact that an item theoretically measures the factor to be tested and has no association with the other factors [44]. Zhu and Kraemer (2005) proposed that when the square root of all factors' AVE is greater than the correlation coefficient between the factor and other factors, meaning DV of the factor is achieved [49]. In Table 6, the square root of AVE values for social support, positive job perception, and negative job perception were 0.826, 0.752 and 0.770, respectively, indicating good DV of the measurement model.

Table 6. AVE Correlation Coefficient Matrix.

	a	b	c
AVE	0.682	0.566	0.593
Social support	0.826		
Positive job perception	0.452 ***	0.752	
Negative job perception	0.053	0.165 ***	0.770

Note: ***: $p \leq 0.001$.

To summarize, through a reliability and validity analysis, the data collected in the questionnaire were reliable and valid and could be used to test theoretical hypotheses.

4. Results

4.1. Status Quo of Chinese Student-Teacher Perception of the Supporting Policy and Intentions to Teach in Rural Schools

From the skewness and kurtosis of each variable, the data came from a normal distribution (Table 7). The table revealed that 43.9% participants had an intention to teach in rural schools. The average value of perception of RRS, social support, positive job perception, and negative job perception was 2.790 (SD = ± 0.793), 2.238 (SD = ± 0.667), 2.497 (SD = ± 0.610), and 2.434 (SD = ± 0.642), respectively. Excluding participants who did not participate in unpaid teaching previously, the average value of previous unpaid teaching satisfaction of those who had participated was 3.257 (SD = ± 0.667), which was at a middle-upper level.

Table 7. Mean, minimum, and maximum of constructs.

Variable	Mean	Standard Deviation (SD)	Minimum	Maximum	Skewness	Kurtosis
Rural employment intentions	0.439	0.497	0.000	1.000	0.248	−1.944
Policy perception	2.790	0.793	1.000	5.000	−0.094	−0.047
Social support	2.238	0.667	0.820	4.100	−0.071	−0.017
Positive job perception	2.497	0.610	0.990	3.990	−0.299	−0.188
Negative job perception	2.434	0.642	0.730	3.660	−0.410	−0.239
Satisfaction with unpaid teaching	3.257	0.667	1.000	5.000	−0.347	0.971

4.2. Correlations between Factors That Influence Student-Teacher Rural Employment Intentions

The Pearson Correlation Coefficient is known as a good method to measure the association or the statistical relationship between variables. As evident from Table 8, rural employment intentions of Chinese student teachers were positively correlated with policy perception (r = 0.165, p = 0.001), positive job perception (r = 0.296, p = 0.001), social support (r = 0.484, p = 0.001), unpaid teaching satisfaction (r = 0.089, p =0.05), current academic qualifications (r = 0.185, p = 0.001), and census registration (r = 0.157, p = 0.001). The correlation between rural employment intentions and other variables (including gender, family type, high school elective courses) was not significant. Second, as to the relationship between independent variables, intermediary variables, and control variables, policy perception was positively related with positive job perception (r = 0.173, p = 0.001), social support (r = 0.152, p = 0.001), unpaid teaching participation (r = 0.172, p = 0.001), and unpaid teaching satisfaction (r = 0.209, p = 0.001). Third, a significant positive correlation was observed between positive job perception and negative job perception (r = 0.141, p = 0.001), social support (r = 0.409, p = 0.001), and academic qualifications (r = 0.139, p = 0.001).

Table 8. Correlations between variables.

Variable		a	b	c	d	e	f	g	h	i	j	k	l
Rural employment intentions	a	1											
Policy perception	b	0.165 ***	1										
Positive job perception	c	0.296 ***	0.173 ***	1									
Negative job perception	d	−0.025	0.082 *	0.141 ***	1								
Social support	e	0.484 ***	0.152 ***	0.409 ***	0.036	1							
Unpaid teaching participation	f	0.046	0.172 ***	−0.041	0.05	0.023	1						
Unpaid teaching satisfaction	g	0.089 *	0.209 ***	0.016	0.079 *	0.086 *	0.971 ***	1					
Gender	h	−0.065	−0.032	−0.014	−0.008	−0.112 **	0.134 ***	0.110 **	1				
One-child family	i	0.025	−0.045	0.047	−0.002	0.011	−0.018	−0.037	0.140 ***	1			
Academic qualifications	j	0.185 ***	0.031	0.139 ***	−0.039	0.228 ***	−0.123 **	−0.103 **	−0.092 *	0.052	1		
High school elective courses	k	−0.116 **	0.036	−0.081 *	−0.035	−0.093 *	0.072	0.07	0.152 ***	−0.021	−0.157 ***	1	
Census registration	l	0.157 ***	0.042	0.059	0.002	0.121 **	0.023	0.024	0.019	0.377 ***	−0.007	−0.04	1

Note: ***: $p \leq 0.001$; **: $p \leq 0.01$; *: $p \leq 0.05$.

4.3. Effects of Perception of RRS on Rural Employment Intentions

The model of the relationship among variables assumed in this study depicts a mediation effect. The dependent variable "rural employment intention" was a dichotomous variable; therefore, this study drew on the test method and process of the mediating effect proposed by [50–52] and used SPSS 26.0 to examine the overall impact of Chinese student-teacher perceptions of RRS on their rural employment intentions, its direct impact on social support and job perception, and direct impact of job perception and social support on rural employment intentions (Table 9). The product of coefficients test was then used in the "RMediation" analysis package to verify that the asymmetric confidence intervals (CIs) for the mediation effect contained 0, and if not, that the mediation effect was significant [53] (Table 10).

Table 9. Regression Coefficient Matrix.

	Rural Employment Intentions		Rural Employment Intentions		Positive Job Perception		Negative Job Perception		Social Support	
	Non. Std. Coeff. (SE)	OR (SE)	Non. Std. Coeff. (SE)	OR (SE)	Non. Std. Coeff. (SE)	Std. Coeff. (SE)	Non. Std. Coeff. (SE)	Std. Coeff. (SE)	Non. Std. Coeff. (SE)	Std. Coeff. (SE)
Policy perception	0.352 **	1.422 **	0.269 *	1.308 *	0.112 ***	0.146 ***	0.047	0.058	0.078 *	0.093 *
	(0.111)	(0.158)	(0.125)	(0.163)	(0.029)	(0.029)	(0.032)	(0.032)	(0.031)	(0.031)
Positive job perception			0.532 **	1.702 **						
			(0.177)	(0.302)						
Negative job perception			−0.285	0.752						
			(0.152)	(0.114)						
Social support			1.675 ***	5.339 ***						
			(0.192)	(1.022)						
Academic qualifications (Undergraduates as the standard)										
Graduate	0.894 ***	2.445 ***	0.489 *	1.631 *	0.146 **	0.104 **	−0.077	−0.052	0.310 ***	0.202 ***
	(0.206)	(0.502)	(0.231)	(0.378)	(0.053)	(0.053)	(0.058)	(0.058)	(0.056)	(0.056)
Unpaid teaching participation (did not take part in unpaid teaching as the standard)										
Unpaid Teaching	−3.112 ***	0.0445 ***	−1.652	0.192	−1.164 ***	−0.888 ***	−0.622 **	−0.451 **	−1.251 ***	−0.873 ***
	(0.890)	(0.0396)	(1.032)	(0.198)	(0.205)	(0.205)	(0.224)	(0.224)	(0.218)	(0.218)
Unpaid Teaching Satisfaction	1.027 ***	2.792 ***	0.587	1.798	0.336 ***	0.861 ***	0.207 **	0.503 **	0.403 ***	0.943 ***
	(0.266)	(0.741)	(0.309)	(0.556)	(0.061)	(0.061)	(0.067)	(0.067)	(0.065)	(0.065)
High school elective courses (Science and Engineering as the standard)										
Literature and history	−0.395 *	0.673 *	−0.367	0.693	−0.083	−0.068	−0.061	−0.048	−0.070	−0.053
	(0.169)	(0.114)	(0.189)	(0.131)	(0.046)	(0.046)	(0.050)	(0.050)	(0.049)	(0.049)
Census registration (Urban as the standard)										
Rural	0.716 ***	2.047 ***	0.618 **	1.855 **	0.040	0.032	−0.014	−0.011	0.161 **	0.120 **
	(0.184)	(0.376)	(0.206)	(0.383)	(0.049)	(0.049)	(0.054)	(0.054)	(0.052)	(0.052)
Gender (Male as the standard)										
Female	−0.179	0.836	−0.015	0.985	0.048	0.028	−0.001	−0.000	−0.129	−0.069
	(0.237)	(0.198)	(0.268)	(0.264)	(0.065)	(0.065)	(0.071)	(0.071)	(0.069)	(0.069)
One child (One-child family as the standard)										
Not one child	−0.120	0.887	−0.152	0.859	0.064	0.046	0.024	0.017	−0.018	−0.012
	(0.211)	(0.187)	(0.237)	(0.204)	(0.056)	(0.056)	(0.062)	(0.062)	(0.060)	(0.060)
Constant term	−1.973 ***	0.139 ***	−5.995 ***	0.00249 ***	2.028 ***		2.365 ***		1.837 ***	
	(0.435)	(0.0606)	(0.785)	(0.00196)	(0.115)		(0.126)		(0.122)	
Pseudo R^2/R^2	0.0915		0.2439		0.099		0.025		0.148	
adj. R^2	-		-		0.088		0.014		0.138	
F	84.71 ***		225.75 ***		9.165 ***		2.178 *		14.459 ***	
Number	675		675		675		675		675	

Note: ***: $p \leq 0.001$; **: $p \leq 0.01$; *: $p \leq 0.05$; β: Regression Coefficient; SE: Standard Error; OR: Odds Ratio.

Table 10. Test of hypotheses.

Path		Point Estimation Effect Value(Standard Error)		95% CIs	Mediation Effect (%)
		Non. Std. Coeff.	Std. Coeff /OR	Non. Std. Coeff.	
Policy perception→Rural employment intentions	c	0.352 ** (0.111)	1.422 ** (0.158)		
Policy perception → Positive job perception	a1	0.112 *** (0.029)	0.146 *** (0.029)		
Positive job perception → Rural employment intentions	b1	0.532 ** (0.177)	1.702 ** (0.302)		
Policy perception → Negative job perception	a2	0.047 (0.032)	0.058 (0.032)		
Negative job perception → Rural employment intentions	b2	0.285 (0.152)	0.752 (0.114)		
Policy perception → Social support	a3	0.078 * (0.031)	0.093 * (0.031)		
Social support → Rural employment intentions	b3	1.675 *** (0.192)	5.339 *** (1.022)		
Policy perception → Rural employment intentions	c′	0.269 * (0.125)	1.308 * (0.163)		
Policy perception → Positive job perception → Rural employment intentions	a1*b1	0.060 (0.026)	-	[0.017, 0.116]	17.04%
Policy perception → Negative job perception → Rural employment intentions	a2*b2	−0.013 (0.013)	-	[−0.043, 0.005]	-
Policy perception → Social support → Rural employment intentions	a3*b3	0.131 (0.054)	-	[0.028, 0.242]	37.21%

Note: ***: $p \leq 0.001$; **: $p \leq 0.01$; *: $p \leq 0.05$.

First, as shown in Table 9, the total impact of Chinese student-teacher perception of RRS on rural employment intentions (β = 0.352, SE = 0.111, OR = 1.422) was significant at $p = 0.05$, indicating that with every 1 unit increase in policy perception, the probability of intentions to teach in rural schools is likely to increase by $e^{0.352}$-1= 42.2%.

Second, as shown in Table 9, the direct effect of student-teacher perception of RRS on their rural employment intentions (β = 0.269, SE = 0.125, OR = 1.308) was significant at $p = 0.05$, indicating that with every 1 unit increase in policy perception, the probability of intention is likely to increase by $e^{0.269}$-1= 30.8%. The direct effect of social support on rural employment intentions (β = 1.675, SE = 0.192, OR = 5.339) was significant at $p = 0.05$, indicating that when social support increases by 1 unit, the probability of teaching in rural schools is likely to increase by $e^{1.675}$-1= 433.9%. The direct effect of student-teacher positive job perception on their rural employment intentions (β = 0.532, SE = 0.177, OR = 1.702) was significant at $p = 0.01$, indicating that when positive job perception increases by 1 unit, the probability of teaching in rural schools would increase by $e^{0.532}$-1 = 70.2%. Student-teacher negative job perception had no significant direct effect on their willingness to teach in rural schools (β = −0.285, SE = 0.152, OR = 0.752).

Third, with respect to other variables, as indicated in Table 9, as compared to the undergraduates, the graduate students had higher rural employment intentions and positive job perception and received more social support. As compared to the urban university student teachers, rural university student teachers had higher rural employment intentions and positive job perception and received more social support. In addition, satisfaction with unpaid teaching in rural schools significantly affected social support that Chinese student teachers could receive and positive and negative job perception. Other variables had no significant effect on rural employment intentions, social support, and positive and negative job perception.

Fourth, as shown in Table 10, with regard to the mediating effect of social support on the relationship between Chinese student-teacher perception of RRS and rural employment intentions, the following results were obtained: (β = 0.131, SE = 0.054, OR = 1.140), and the 95% confidence interval [0.028, 0.242] did not contain 0, indicating that social support had a partial mediating effect (37.21%) on the relationship between the perception of RRS and rural employment intentions. As to the mediating effect of positive job perception on the relationship between Chinese student-teacher perception of RRS and rural employment intentions (β = 0.060, SE = 0.026, OR = 1.062), the 95% confidence interval [0.017, 0.116] did not contain 0, showing that positive job perception had a partial mediating effect (17.04%) on the relationship between the perception of RRS and rural employment intentions. As the 95% confidence interval [−0.043, 0.005] contained 0, there was no mediating effect of negative job perception on the relationship between policy perception and rural employment intentions.

5. Discussions

This study investigated an unrevealed but pivotal dimension of student-teacher rural employment intentions (i.e., policy perception). Microdata were collected to explore Chinese student-teacher perception of RRS, intentions to teach in rural schools, and impacts of push and pull factors influencing their intentions. Our empirical analysis has yielded the following results:

First, Chinese student-teacher perception of RRS was a little below average. This finding indicates that a number of student teachers have insufficient knowledge of RRS and the teaching profession and lack concepts of serving rural education. This finding corroborates the ideas of Liu et al (2020), who revealed that only 7.6% of Chinese rural teachers were familiar with supporting policies, while 40.6% of special-post teachers and 51.4% of postgraduate teachers in rural education knew little about them [54]. In addition, the student teachers in our study showed that they received some support from parents, classmates, and friends and believed that rural teacher professional development and promotion were encouraging to some extent, that the working environment was acceptable,

and that the working pressure and cost in rural areas were relatively low. This speaks to the previous findings that according to applied psychology, employees intend to work if provided with more rewards and less stresses, but this is not always the case, especially for those who want to be teachers. Many pre-service and in-service teachers expressed that they became teachers because they wanted to make a difference in their students, and the value of this job went beyond the trade-off between job rewards and cost [55].

Second, our analysis shows that Chinese student-teacher perception of RRS positively influenced their intentions to teach in rural areas through mediation effects of social support and positive job perception. These findings suggest that the student teachers who have a positive perception of RRS are more likely to understand the policy implementation, more confident to adapt to the policy change, and more willing to incorporate the policy into their life. On the contrary, student teachers who negatively perceive the policy and regard it as "deceptious" "unsustainable", and "unacceptable" are less likely to respect the policy and comply with it. These findings are consistent with previous work [27,56,57], which showed that to a great extent, the policy propaganda highlights the understanding, faith, and gratification of student teachers, and these feelings are required for the successful execution and compliance with the policy. Thus, to facilitate acceptance of the policy by the student teachers, their family members and friends, policy propaganda, and sufficient time are needed for "diffusion" and adaptation to occur [58]. By allowing more people to become involved in the policy development and advocacy, the propaganda efforts would be more fruitful. If members of the public are allowed sufficient time to assess how the policy affects them, they can acclimatize themselves to it.

Our analysis also highlights that the more support student teachers receive from their family, friends, and classmates, the greater their intention will be to teach in rural areas. These results conform with those reported in earlier studies, which have demonstrated that social cognitive factors, such as support from others and organizations, play an important role in employee job satisfaction, organizational commitment, professional identity, and career decisions, particularly for those working in underprivileged districts [55,59–62]. In other words, if policies, such as the RRS, are introduced without due regard to social factors, they cannot exert a sufficient impact and encourage people to seek employment as teachers in rural schools.

As to positive job perception, our quantitative analysis revealed that when Chinese student teachers provide higher ratings to "career development," "work environment," and "promotion opportunities" of rural teachers, they are likely to be more willing to work in rural schools. In addition, though negative job perception is not a significant predictor of employment intentions [63], Chinese student-teacher work pressure and cost of living still exist and should be taken into consideration. According to positive psychology, distinguishing one's mental assets is a crucial move toward a meaningful life [64]. If a positive outlook is adopted by the student teachers with respect to the policy, then they are likely to be more confident with regard to its possible disadvantages and are likely to be more willing to tackle difficulties and facilitate adaptation.

Third, our analysis revealed that a difference in academic qualifications, census registration, and unpaid teaching satisfaction exists in Chinese student-teacher intentions to teach in rural schools. Specifically, compared to undergraduates, graduate students received more social support, perceived their jobs more positively, and possessed higher intentions to teach for ESD. This finding also accords with earlier observations, which showed that in many rural areas of China, substantial remuneration was provided to graduate students in the form of higher positions and salaries, faster promotion, and more opportunities. In addition, because of pressure due to the existing competitive situation, more and more university students apply for postgraduate entrance examinations instead of applying for a job. According to the statistical data reported by the Ministry of Education of China, about 4.57 million students participated in the exam in 2022, reaching an all-time high in China [65]. Therefore, better working conditions and treatment of undergraduates

need to be provided. Otherwise, many of them will refuse to search for jobs, let alone teach in rural areas.

Moreover, compared to urban participants, rural participants receive more social support, perceive their job more positively, and are more willing to go back to teach in rural schools. This result matches that found in previous studies, which have speculated that because the economic status of rural teachers is lower than their peers in the cities [66], student teachers growing up in cities are more sensitive to the difference and have less intention to work in rural areas [55]. In this way, the government, universities, and teacher educators need to cultivate the "rural sense" of student teachers to help them develop stable emotions toward ESD. In addition, future policies could probably focus on urban students and their parents and improve their perception of the rural districts. Furthermore, national and township governments should not only attract teachers outside the towns, but also make great efforts to cultivate and retain local teachers as they might have deeper feelings for their hometowns.

Compared to those without unpaid teaching experience, Chinese student-teacher participants with unpaid teaching experience and satisfaction with it have higher rural employment intentions. Thus, opportunities to undertake internships in rural schools could be provided for student teachers to help them gain knowledge of rural education.

The generalizability of our results is subject to certain limitations that also suggest future research directions. First, most of our participants were females. Future studies can be performed with a more evenly distributed sample having approximately the same number of males and females. Second, this study examined the roles of policy perception, social support, and job perception in influencing rural employment intentions. Future studies can investigate other variables. Third, the sample was limited to Chinese student teachers. Future work could be carried out with a broader and larger sample size.

The findings of our study have several important implications for future practice and other countries, which are also facing a shortage, loss, and low quality of rural teachers [67]. National and regional governments and rural schools need to continue to publicize the related supporting policies such as RRS and focus on building platforms for rural teacher employment and development, improving their working conditions, such as reducing class size and shortening working hours by reducing teacher errands and increasing their perception of their status of income. Universities and teacher educators need to foster student-teacher readiness to analyze the idea of ESD and contemplate the meaning of teaching in rural schools for children, for oneself, and for society as a whole. Members of student-teacher social networks need to improve their perception of related policies, communicate with student teachers, and encourage them to serve the poor areas.

6. Conclusions

This study empirically investigated the student-teacher policy perception of RRS and rural employment intentions, examined two categories of antecedents for intentions to teach in rural schools: push (i.e., low policy perception and negative job perception) and pull factors (high policy perception, social support, and positive job perception), and explored the push and pull effects of these variables. These findings clearly portray what constitutes the push and pull forces and contribute to our understanding of the role of policy perception, social support, and job perception in student-teacher decisions to teach in rural schools for ESD.

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References

1. Aaronson, D.; Barrow, L.; Sander, W. Teachers and student achievement in the Chicago public high schools. *J. Labor. Econ.* **2007**, *25*, 95–135. [CrossRef]
2. Chetty, R.; Friedman, J.N.; Rockoff, J.E. Measuring the impacts of teachers II: Teacher value-added and student outcomes in adulthood. *Am. Econ. Rev.* **2014**, *104*, 2633–2679. [CrossRef]
3. Bertschy, F.; Künzli, C.; Lehmann, M. Teachers' Competencies for the Implementation of Educational Offers in the Field of Education for Sustainable Development. *Sustainability* **2013**, *5*, 5067–5080. [CrossRef]
4. Indicators of Successful Teacher Recruitment and Retention in Oklahoma Rural Schools. Available online: https://eric.ed.gov/?id=ED576669 (accessed on 6 April 2022).
5. Monk, D.H. Recruiting and Retaining High-Quality Teachers in Rural Areas. *Future Child.* **2007**, *17*, 155–174. [CrossRef]
6. Hanushek, E.A.; Kain, J.F.; Rivkin, S.G. Why public schools lose teachers. *J. Hum. Resour.* **2004**, *39*, 326–354. [CrossRef]
7. Loeb, S.; Kalogrides, D.; Béteille, T. Effective schools: Teacher hiring, assignment, development, and retention. *Educ. Financ. Policy* **2012**, *7*, 269–304. [CrossRef]
8. Zhang, H.; Cheng, X.; Cui, L. Progress or stagnation: Academic assessments for sustainable education in rural china. *Sustainability* **2021**, *13*, 3248. [CrossRef]
9. Zhai, X. Becoming a teacher in rural areas: How curriculum influences government-contracted pre-service physics teachers' motivation. *Int. J. Educ. Res.* **2019**, *94*, 77–89. [CrossRef]
10. Central Committee of the Communist Party of China (CPC) and the State Council. China Releases Five-Year Plan on Rural Vitalization Strategy. Available online: http://www.gov.cn/zhengce/2018-09/26/content_5325534.htm (accessed on 6 April 2022).
11. Xue, E.; Li, J.; Li, X. Sustainable development of education in rural areas for rural revitalization in china: A comprehensive policy circle analysis. *Sustainability* **2021**, *13*, 13101. [CrossRef]
12. The 2018 Central, No. 1 Document Fully Deploys and Implements the Rural Revitalization Strategy- Give Priority to the Development of Rural Education, Build a Strong Rural Teacher Team. Available online: http://www.moe.gov.cn/jyb_xwfb/gzdt_gzdt/s5987/201802/t20180205_326624.html (accessed on 6 April 2022).
13. Arco, I.D.; Ramos-Pla, A.; Zsembinszki, G.; Gracia, A.D.; Cabeza, L.F. Implementing sdgs to a sustainable rural village development from community empowerment: Linking energy, education, innovation, and research. *Sustainability* **2021**, *13*, 12946. [CrossRef]
14. O'Faircheallaigh, C. Public participation and environmental impact assessment: Purposes, implications, and lessons for public policy making. *Environ. Impact. Asses.* **2010**, *30*, 19–27. [CrossRef]
15. Appleton, S.; Sives, A.; Morgan, W.J. The impact of international teacher migration on schooling in developing countries—The case of Southern Africa. *Glob. Soc. Educ.* **2006**, *4*, 121–142. [CrossRef]
16. Göbel, C. Uneven policy implementation in rural China. *China. J.* **2011**, *65*, 53–76. [CrossRef]
17. Qian, H.; Walker, A. How principals promote and understand teacher development under curriculum reform in China. *Asia-Pac. J. Teach. Edu.* **2013**, *41*, 304–315. [CrossRef]
18. Boswell, M.; Rozelle, S.; Zhang, L.; Liu, C.; Luo, R.; Shi, Y. Conducting influential impact evaluations in China: The experience of the Rural Education Action Project. *J. Dev. Effect.* **2011**, *3*, 420–430. [CrossRef]
19. Young, D.J. Rural and urban differences in student achievement in science and mathematics: A multilevel analysis. *Sch. Eff. Sch. Improv.* **1998**, *9*, 386–418. [CrossRef]
20. Chen, Y.; Zhang, Y. Effects of free compulsory education on rural well-being in China. *Asian-Pac. Econ. Lit.* **2020**, *34*, 78–92. [CrossRef]
21. Glewwe, P.; Muralidharan, K. *Improving Education Outcomes in Developing Countries: Evidence, Knowledge Gaps, and Policy Implications*; Elsevier Besloten Vennootschap: Amsterdam, The Netherlands, 2016.
22. Lou, D.; Guo, H.D. Analysis of factors affecting college students' will to work in rural areas: An empirical study based on a survey of students in Zhejiang province. *J. Northwest A F Univ. (Soc. Sci. Ed.)* **2008**, *11*, 127–131.

23. Zhong, Y.; Liu, S. The influencing factors of college students' rural employment intention in the context of the rural revitalization strategy. *J. High. Educ-UK.* **2019**, *40*, 88–97.
24. Bansal, H.S.; Taylor, S.F.; James, Y.S. "Migrating" to new service providers: Toward a unifying framework of consumers' switching behaviors. *J. Acad. Mark. Sci* **2005**, *33*, 96–115. [CrossRef]
25. Moon, B. Paradigms in migration research: Exploring "moorings" as a schema. *Prog. Hum. Geog.* **1995**, *19*, 504–524. [CrossRef] [PubMed]
26. Lengerke, T.V.; Vinck, J.; Rütten, A.; Reitmeir, P.; Abel, T.; Kannas, L.; Lüschen, G.; Diaz, J.A.R.; Zee, J.V.D. Health policy perception and health behaviours: A multilevel analysis and implications for public health psychology. *J. Health Psychol.* **2004**, *9*, 157–175. [CrossRef] [PubMed]
27. Marshall, N.A. Can policy perception influence social resilience to policy change? *Fish. Res.* **2007**, *86*, 216–227. [CrossRef]
28. Zhe, C.; Guo-Hong, C. The influence of green technology cognition in adoption behavior: On the consideration of green innovation policy perception's moderating effect. *J. Discret. Math. Sci. Cryptogr.* **2017**, *20*, 1551–1559.
29. Fu, Y.C.; Fu, W.D. An empirical study on the employment intention and its influencing factors of the first free-tuition undergraduates of the six ministerial normal universities in China. *J. Cent. China Norm. Univ. (Humanit. Soc. Sci.)* **2011**, *50*, 144–152.
30. Uygun, R.; Kasimoglu, M. The emergence of entrepreneurial intentions in indigenous entrepreneurs: The role of personal background on the antecedents of intentions. *Int. J. Bus. Manag.* **2013**, *8*, 24–41. [CrossRef]
31. Otache, I. Entrepreneurship education and undergraduate students'self- and paid-employment intentions: A conceptual framework. *Educ. Train.* **2019**, *61*, 46–64. [CrossRef]
32. Kim, J. The Impacts of Self—leadership and Participation in Job Search Supporting Programs on Employment Intention of Senior Students in University: The Mediating Effect of Career Motivation. *Korean Bus. Educ. Rev.* **2015**, *30*, 377–405.
33. Gao, F.S.; Tilse, C.; Wilson, J.; Tuckett, A.; Newcombe, P. Perceptions and employment intentions among aged care nurses and nursing assistants from diverse cultural backgrounds: A qualitative interview study. *J. Aging. Stud.* **2015**, *35*, 111–122. [CrossRef]
34. Hudson, P.; Hudson, S. Changing preservice teachers' attitudes for teaching in rural schools. *Aust. J. Teach. Educ.* **2008**, *33*, 67–77. [CrossRef]
35. Brill, S.; McCartney, A. Stopping the revolving door: Increasing teacher retention. *Politics Policy* **2008**, *36*, 750–774. [CrossRef]
36. Cobb, S. Social support as a moderator of life stress. *Psychosom. Med.* **1976**, *38*, 300–314. [CrossRef] [PubMed]
37. Thoits, P.A. Conceptual, methodological, and theoretical problems in studying social support as a buffer against life stress. *J. Health Soc. Behav.* **1982**, *23*, 145–159. [CrossRef] [PubMed]
38. Werner, S. Can self-efficacy mediate between knowledge of policy, school support and teacher attitudes towards inclusive education. *PloS ONE* **2021**, *16*, e0262625. [CrossRef]
39. Alam, G.M.; Roslan, S.; Al-Amin, A.Q.; Filho, W.L. Does GATS' Influence on Private University Sector's Growth Ensure ESD or Develop City 'Sustainability Crisis'—Policy Framework to Respond COP21. *Sustainability* **2021**, *13*, 1–21. [CrossRef]
40. Muschalla, B. Mental health problem or workplace problem or something else: What contributes to work perception. *Disabil. Rehabil.* **2020**, *42*, 502–509. [CrossRef]
41. Kim, C.; Ngo, H.; Playford, D. Gender equity at last: A national study of medical students considering a career in rural medicine. *BMC Med. Educ.* **2020**, *20*, 432. [CrossRef]
42. Pugliesi, K. The Consequences of Emotional Labor: Effects on Work Stress, Job Satisfaction, and Well-Being. *Motiv. Emotion.* **1999**, *23*, 125–154. [CrossRef]
43. Liu, T. Study on the Influencing Factors and Countermeasures of Rural College Students' Willingness to Return to Their Hometowns for Employment and Entrepreneurship. Master's Thesis, Hubei University, Wuhan, China, 2019.
44. Thakkar, J.J. *Structural Equation Modelling: Application for Research and Practice (with AMOS and R)*; Springer: Singapore, 2020.
45. Kopalle, P.K.; Lehmann, D.R. Alpha inflation? The impact of eliminating scale items on Cronbach's alpha. *Organ. Behav. Hum. Decis. Processes* **1997**, *70*, 189–197. [CrossRef]
46. Bartlett, M.S. Tests of significance in factor analysis. *Br. J. Med. Psychol.* **1950**, *3*, 77–85. [CrossRef]
47. Koufteros, X.A. Testing a model of pull production: A paradigm for manufacturing research using structural equation modeling. *J. Oper. Manag.* **1999**, *17*, 467–488. [CrossRef]
48. Shevlin, M.; Miles, J.N. Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. *Pers. Indiv. Differ.* **1998**, *25*, 85–90. [CrossRef]
49. Zhu, K.; Kraemer, K.L. Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Inform. Syst. Res.* **2005**, *16*, 61–84. [CrossRef]
50. Zhao, L.; Rashid, H. The mediating role of work-leisure conflict on job stress and retention of it professionals. *Acad. Inf. Manag. Sci. J.* **2010**, *13*, 25–40.
51. Wen, Z.L.; Ye, B.J. Mediating effect analysis: Methods and model development. *Adv. Psychol. Sci.* **2014**, *22*, 731–745. [CrossRef]
52. Fang, J.; Wen, Z.; Hau, K.T. Mediation effects in 2-1-1 multilevel model: Evaluation of alternative estimation methods. *Struct. Equ. Modeling* **2019**, *26*, 591–606. [CrossRef]
53. MacKinnon, D.P.; Cox, M.G. Commentary on "Mediation analysis and categorical variables: The final frontier" by Dawn Iacobucci. *J. Consum. Psychol.* **2012**, *22*, 600–602. [CrossRef]

54. Liu, Y.W.; Zhang, Y.J.; Feng, W.B. Difficulties and Breakthroughs in Strengthening the Ranks of Rural Teachers:Based on the Survey of Rural Teachers' Perception and Attitude Towards Policy. *J. Chin. Soc. Educ.* **2020**, *6*, 95–100.
55. Tang, Y.P. It's not only work and pay: The moderation role of teachers' professional identity on their job satisfaction in rural China. *Appl. Res. Qual. Life* **2020**, *15*, 971–990. [CrossRef]
56. Jiang, C.; Li, X.Q. Policy's perception and the college graduates' grass-root employment: Based on the Bandura's reciprocal determinism. *Peking Univ. Educ. Rev.* **2015**, *13*, 47–56.
57. Beckley, T.M. Community stability and the relationship between economic and social well-being in forest-dependent communities. *Soc. Nature Resour.* **1995**, *8*, 261–266. [CrossRef]
58. Yang, X.Y. Research on the Implementation of Grassroots Employment Policy for College Students in Local Colleges and Universities. Master's Thesis, Sichuan Normal University, Chengdu, China, 2021.
59. Schepens, A.; Aelterman, A.; Vlerick, P. Student teachers' professional identity formation: Between being born as a teacher and becoming one. *Educ. Stud-UK* **2009**, *35*, 361–378. [CrossRef]
60. Baranik, L.E.; Roling, E.A.; Eby, L.T. Why does mentoring work? The role of perceived organizational support. *J. Vocat. Behav.* **2010**, *76*, 366–373. [CrossRef] [PubMed]
61. Lamote, C.; Engels, N. The development of student-teachers' professional identity. *Eur. J. Teach. Educ.* **2010**, *33*, 3–18. [CrossRef]
62. Mostafa, T.; Pál, J. Science teachers' satisfaction: Evidence from the PISA 2015 teacher survey. *OECD Publ.* **2018**.
63. Fiksenbaum, L.; Jeng, W.; Koyuncu, M.; Burke, R.J. Work hours, work intensity, satisfactions and psychological well-being among hotel managers in China. *Cross. Cult. Manag.* **2010**, *17*, 79–93. [CrossRef]
64. Yu, C.J.; Zhang, L.; Miao, R.F.; Wang, M.Z. Changes and prospects of rural teacher compensation policy from the perspective of positive psychology. *Psychiat. Danub.* **2021**, *33*, S265–S266.
65. Preparations for the 2022 National Master's Degree Entrance Examination are Underway. Available online: http://www.moe.gov.cn/jyb_xwfb/gzdt_gzdt/s5987/202112/t20211222_589176.html (accessed on 6 April 2022).
66. Xie, Y.; Hannum, E. Regional variation in earnings inequality in reform-era urban China. *Am. J. Sociol.* **1996**, *101*, 950–982. [CrossRef]
67. Kline, J.; White, S.; Lock, G. The Rural Practicum: Preparing a Quality Teacher Workforce for Rural and Regional Australia. *J. Res. Rural Educ.* **2013**, *28*, 1–13.

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Article

How Do Different Types of University Academics Perceive Work from Home Amidst COVID-19 and Beyond?

Nilmini M. Rathnayake [1,*], Pivithuru J. Kumarasinghe [2] and Ajantha S. Kumara [3]

[1] Department of Business Management, SLIIT Business School, Sri Lanka Institute of Information Technology (SLIIT), Malabe 10115, Sri Lanka
[2] Department of Business Economics, Faculty of Management Studies and Commerce, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka; pivithuru@sjp.ac.lk
[3] Department of Public Administration, Faculty of Management Studies and Commerce, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka; mhasisira@sjp.ac.lk
* Correspondence: nilmini.r@sliit.lk; Tel.: +94-71-603-2176

Abstract: The COVID-19 pandemic resulted in a massive and unintentional shift to work from home (WFH) or working remotely, as well as broad adoption of web-based platforms. The goal of this research is to uncover the attitudes to WFH among different types of academics in the Sri Lankan higher education sector. An online questionnaire survey was conducted amidst a severe COVID-19 wave during June–September 2021, and 337 valid responses were received. The questionnaire contained 49 questions under four sections excluding demographic questions. The gathered data were analysed using multiple regression models. Results of the study ascertained a significant ($p < 0.01$) positive attitude among academics towards online teaching (academic orientation), other than academics who from disciplines with more practical components, and there was a significant ($p < 0.01$) positive attitude among academics to conducting research (research orientation) while WFH. Further, the findings indicate a significant ($p < 0.01$) negative attitude to WFH when disseminating knowledge and engaging in community services with various stakeholders. When considering the criticality of demographics variables in the new normal, a hybrid working model can be introduced by reaping the benefits of WFH based on different types of academic orientations and their favourability towards the WFH model, rather than reverting to a full physical academic working environment. As a developing country, Sri Lanka can formulate policies on effective hybrid working models for academics to realise the potential from the lessons learned. This experience will enable the country to accomplish or move towards accomplishing the fourth goal of SDGs, quality education by 2030.

Keywords: COVID-19; hybrid work model; university academics; work from home (WFH)

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1. Introduction

The coronavirus outbreak, globally known as COVID-19, created a global economic shock overwhelming all countries with challenges and uncertainty. The novel pandemic has already negatively affected daily lifestyles and the livelihoods of most individuals across the globe, and is still ongoing with emerging waves. However, it has created a digital revolution simultaneously in the majority of sectors worldwide. To minimise disruptions caused by the pandemic such as mobility restrictions and social distancing, working on virtual platforms has been the only available method so far for business survival. As a result, private companies, public organisations, schools, and universities have adopted offsite working, requesting their employees too to start performing their job roles staying at home or working from home (WFH) [1–18]. In the new normal condition, the WFH concept is a widely debated topic in various and diverse sectors. Hence, the impacts of COVID-19 on workers and workplaces in different countries have been complex and unique. Sri Lanka is among the countries most affected by the pandemic's third wave, the highly transmissible delta variant with a high number of infected cases and death rates.

Hence, there was another sudden shift from the physical working environment to the virtual platform (after the first wave in early 2020) as companies increasingly continued WFH practices. The online questionnaire survey for the present study was active from June to September 2021, during this wave and extensive lockdown period (with multiple lockdowns), when the daily number of new infections each day exceeded 2000.

Due to the COVID-19 pandemic, the government's coping strategies include stringent social distancing intervention during lockdown periods. Hence, the majority of employees had to continue their duties and responsibilities while staying at home or working remotely. This condition was applicable for university academic staff. University academics play a role covering three major domains of teaching, research, and community services or dissemination of knowledge [19,20]. Hence, the success of WFH heavily depends on the comfortability of performing duties and responsibilities relevant to each domain. There are types of academics who are more oriented towards one of the aforesaid three. Hence, the orientation of an academic depends on his/her dominant domain, and their attitude towards the concept of WFH may vary. Therefore, it is necessary to find out the attitude of different types of academics to the concept of WFH. Currently, there is a paucity of scientific research regarding COVID-19's impact on academic outcomes [21], and thus, a research gap exists globally on this topic and area of study. Further, to the best of our knowledge, the consequences of COVID-19 on educational aspects have not yet been examined in the Sri Lankan context. Hence, this study is an attempt to bridge the research gap to a certain extent by examining how Sri Lankan academics perceive WFH, based on their orientations.

The findings provide a practical and helpful approach to determine the nature and the magnitude of the impact created by WFH on a multitude of academics. This publication carries unique findings in relation to the perspectives of Sri Lankan academics, and it will assist academics as well as policymakers in formulating policies in a health crisis like COVID-19. First, the current study allows academics to identify the priorities that should be considered when performing official duties through distance working or remote working. University regulatory bodies will also have a better awareness of the type of tasks, resources etc., required for effective WFH on diverse work platforms. In addition, authorities will gain valuable insights into the types of minimum facilities or requirements that should be provided and embedded to educational systems, and values to be inculcated among academics for successful moving and shifting from the on-premises working environment to a virtual environment.

Second, in the backdrop of the COVID-19 pandemic, it is essential to identify the collaboration impact of WFH on academics. In this regard, the current study helps both parties, including academics and regulatory bodies, to recognise and adopt new normal conditions by considering the different types of academics' attitudes; this kind of approach will be instrumental in developing a mutually acceptable and effective work model for academic institutions.

Third, there has been exceptionally scarce earlier research in the Sri Lankan setting to emphasise future implications and policymaking related to university academics and the WFH concept. Finally, the study findings will be useful to policymakers of apex bodies in Sri Lankan higher education in an endeavour to recuperate from the economic downturn and enhance the productivity of academic staff members. Hence, the main objective of this study is to identify the attitude of different types of academics towards the WFH practice in the Sri Lankan context. Therefore, this study differs from preceding studies and contributes to the prevailing literature in the four ways elaborated above.

2. Literature Review

The literature review is segregated into main four sections; on WFH; academics' orientation towards teaching (OTT); orientation towards research, scholarship and creative work (OTRSC); and orientation towards dissemination of knowledge (OTDOK) amidst academics performing roles via remote working. Figure 1, flow diagram summarizes the process of studies found, excluded in each phase of the literature review.

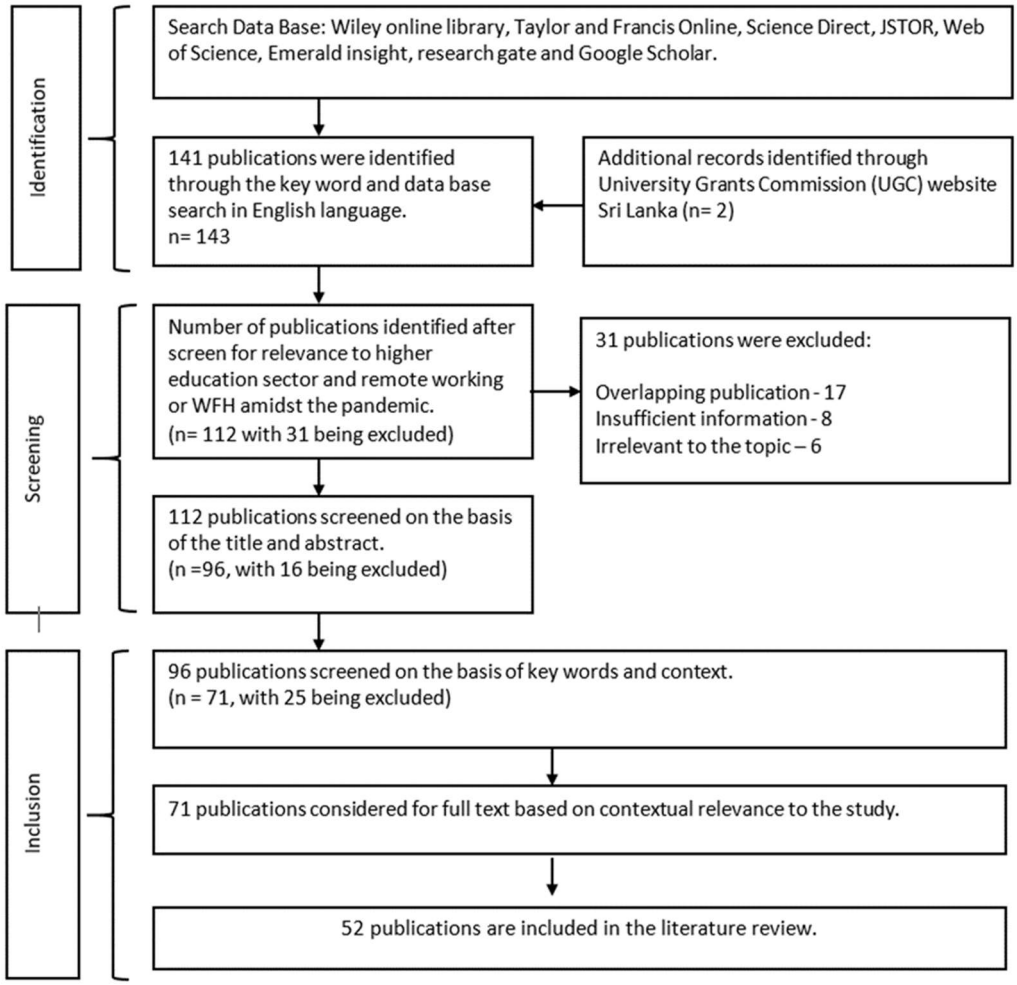

Figure 1. Literature source flow diagram. Source: Based on author's observations and [22].

WFH is not an alien concept in the literature. It was the immediate and feasible solution for performing the job roles of the majority of employees across a multitude of sectors, while some essential workers physically reported to workplaces. The concept is known as "telecommuting", and was first introduced during the 1970s and 1980s by accessing personal computers and networking facilities (Olson, 1983, as cited in [13]. Subsequently, the concept expanded gradually across diverse sectors and especially in information technology-related sectors. However, such sectors also had an on-premises work culture prior to the pandemic, unless it was essential to WFH [4,9]. As noted previously, to curb the pandemic spread, sudden lockdowns and tight travel restrictions affected the environment to minimise the congregation of people. Subsequently, most employees had to stay at home to protect themselves and others from virus contamination.

In the initial stages of WFH, there were several drawbacks and difficulties with the unprepared hurried shift from physical to the virtual environment. The main issues experienced include less efficiency, high work stress levels, poorer working conditions at home, inadequate social interaction, very limited knowledge of online teaching methods and difficulty conducting accurate assessment processes [23,24]. The above-mentioned studies conducted on future WFH -related research activities highlighted the necessity of analysing the diversity of work arrangements. According to these scholars, a requirement exists for examining how WFH is perceived by many types of employees in terms of productivity, creativity and innovation [25]. The COVID-19 pandemic created an opportunity for many organisations globally to experience the WFH concept in real terms and thus to acquire hands-on experience in this regard. When considering such experience using quantitative

as well as qualitative approaches, several empirical studies have identified pros and cons in diverse contexts [26–34].

Moreover, there is a high probability of strengthening traditional gender roles when working from home. Potential negative impacts on females' career prospects may be due to childcare and mothers shouldering a higher burden of household workload compared to fathers [3,35–37]. Therefore, the existing literature provides evidence on gender-related gaps when practising the WFH concept [38,39]. Similarly, WFH practices can trigger stressful conditions for some employees due to socio-demographic factors [40–43].

An Indonesian study revealed that an individual's digital capability significantly affects productivity when WFH during a pandemic like COVID-19. Moreover, certain arrangements are needed to develop and refine WFH efforts, which may be based on the experience of tackling tasks during a pandemic [1]. Similarly, another Indonesian study highlighted several advantages of WFH, such as being more flexible in completing work, saving costs of transportation, minimum level of stress experienced in traffic jams, flexible office hours and having more free time. Simultaneously, these scholars highlight a few disadvantages like less work motivation, electricity and internet costs, and data security issues [44]. Meanwhile, according to a study conducted in 29 European countries on the experiences of knowledge workers, the majority of employees had a "more positive rather than negative experience of WFH during lockdown" [45]. Hence, there is a high possibility of continuing the WFH concept even beyond the pandemic, particularly for knowledge workers, including university academics.

As COVID-19 forces universities to shift from traditional in-class delivery to online delivery, e-learning has become a major teaching-learning tool to continue educational activities [46]. Initially, university academics had to face an unexpected shock until they were able to manage this sudden change in the teaching-learning environment. Generally, the higher education sector swiftly adapts to technological features such as the Internet, the use of big data, Artificial Intelligence, and virtual teaching or learning platforms [47]. Furthermore, online teaching opens the door for several other benefits by creating more opportunities for learners. The literature emphasises that the development of university academics' capacity for online teaching will lead to improving the quality of education for a sustainable future [47–49]. This is further witnessed from the study related to training teachers for online teaching amidst the pandemic. Here, findings were confirmed by employing a range of innovative practices to create engaging classrooms, using different online tools and establishing a closer relationship for learner participation [50,51].

In a short period, various universities worldwide have responded with digital approaches and hybrid classrooms during the COVID-19 pandemic [52]. The majority of the developed countries in the world swiftly adapted to online learning or hybrid learning systems in their higher education sectors, while there was a delay in developing countries. Sri Lanka, as a developing country with no hybrid learning activities practised prior to the pandemic, hence underwent a delay in responding to the sudden COVID outbreak. After practising for a few months, the higher education sector switched fully to online teaching methods using online teaching platforms. Therefore, offline learning transformed to online learning due to COVID-19. Hence, teachers and learners experienced purely offline methods before the pandemic, and purely online methods amidst the pandemic, due to less exposure to hybrid methods. Therefore, the pandemic allowed developing nations to experience the online learning and teaching world, and later they realised the pros and cons of both approaches.

According to an empirical study, university teachers in Jordan displayed psychological distress and challenges when practising distance teaching [53]. Importantly, a high level of practical requirements are embedded in certain online teaching disciplines that makes the task increasingly challenging compared to teaching highly theoretical disciplines [54]. "Medical education delivery needs to be sustained with decentralised, remote and technology enabled formats" [55]. Regardless of challenges at the beginning, with gradual digital transformation, this problem has been overcome [56,57]. Furthermore, empirical

findings proved that technology usage has rapidly grown among academics in various fields, creating more opportunities for the involvement of multiple learners on a global scale for the process of teaching. Also, it is noted that virtual learning may be suitable for training-based teaching, but currently an underutilisation of such tools is observed [58].

Accordingly, we postulate the following hypothesis:

Hypothesis 1. *More teaching-oriented academics have a positive attitude towards WFH.*

The pandemic has created a need for alternative working conditions to conduct research activities, as one of the roles of academics [59]. Working in academia, to cater to the basic requirements expected from universities on research key performance indicators (KPIs), they had no option other than involvement in research work while staying at home. As a consequence, academics needed to broaden their connections and expand their networks to develop trust among academic colleagues beyond national borders, unlike earlier occasions [60]. Hence, this was a remarkable turning point in the rise of scientific globalism, which can be proven when comparing publications before and after the COVID-19. Especially, this brought benefits to countries with lower gross domestic product (GDP) that were severely affected by the pandemic [60,61]. Similarly, emerging methods of collecting and sharing data virtually within a highly collaborative research setting can be observed [62,63].

Simultaneously, one could observe academics working with research projects and research supervisions without discontinuation via virtual platforms in an effective way with flexible schedules [63,64]. In addition, the study concluded that performing research activities via virtual modes creates more opportunities to improve research outcomes. Hence, in the post-pandemic context universities can reconsider research strategies based on experiences accumulated from WFH; here, their purpose is to enhance the quality of education with impactful research [65]. Moreover, the novel platform will strengthen academic researchers in a sustained way by breaking several barriers of physical representation [60].

Accordingly, we establish the following hypothesis:

Hypothesis 2. *More research-oriented academics have a positive attitude towards WFH.*

At an unprecedented time, it is a challenge to facilitate disseminating knowledge and to get involved with community services in ordinary ways, unlike in circumstances before the pandemic. Thus, prior to the pandemic, technology did not play a significant role in the knowledge-sharing-behaviour of academics [66]. Moreover, physical representation and formalities were mandatory in local academic institutions. However, the technology contributed to the knowledge sharing process, after establishing trust within the collaborative environment among academics who were eager to disseminate knowledge [67].

During the pandemic, annual conferences and workshops were conducted online allow larger participation from various geographical areas worldwide [62]. Virtually, there is potential for greater opportunity for developing nations to obtain wider foreign exposure. Therefore, during the pandemic, by performing academic roles remotely, academics could use a considerably larger platform for knowledge sharing, "Educational institutions highly prefer online platforms for knowledge sharing and learning purposes" [46]. Consequently, the new normal situation allows academia to share international level best practice and expertise at the local level [58].

In contrast, in a case study carried out in Peru based on two universities, researchers revealed that the WFH system used during the pandemic had a number of critical challenges and drawbacks for disseminating knowledge; hence, it requires innovations and new perspectives of knowledge management [68]. Aligning with the same argument, another study highlighted that stakeholders in the higher education sector expressed feelings of deficiency of knowledge-sharing amidst COVID-19 [69]. Even with the pandemic, there is a role for academia to play regarding knowledge dissemination with relevant stakeholders [70].

On this backdrop, the following hypothesis is postulated:

Hypothesis 3. *More practitioner (knowledge dissemination) oriented academics have a positive attitude towards WFH.*

3. Methodology

The study proposal was reviewed and approved by the Department of Business Economics, Faculty of Management Studies and Commerce, University of Sri Jayewardenepura, Sri Lanka. Cross-sectional data collection was conducted using a self-administered online questionnaire, with the participation of academic staff members in Sri Lankan Higher Education Institutions (HEIs). The questionnaire consisted of five sections. The first section was the individual's demographic profile and the subsequent sections respectively collected relevant data for the main study variables in the current study.

According to the University Grants Commissions (UGC) website, 6525 teaching staff members are employed in Sri Lanka, comprising 31.3% lecturers, 53.3% senior lecturers and 15.4% professors [71]. Figure 2 shows the composition of academic members gender-wise.

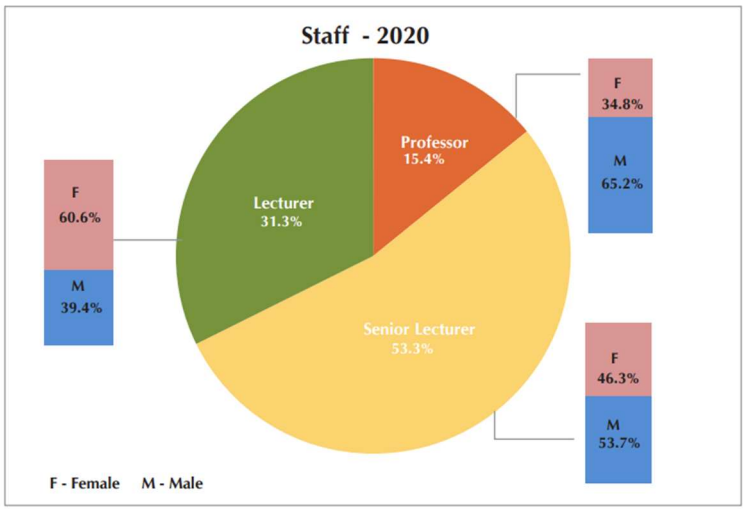

Figure 2. Sri Lankan higher education institutions teaching staff composition. Source: [71].

Out of this total of 6525 academic staff members, the distribution of educational qualifications were: 1st degree and postgraduate diploma 18.2%, 20% Master's degree, 10.9% MPhil, 7.8% Doctor of Medicine (MD)/Master of Science (MS) and 43.1% with PhD and other Doctoral degrees. The distribution of teaching staff according to the age group was: 21–30 years (9.25%), 31–40 years (34.50%), 41–50 years (28.31%), 51–60 years (22.56%) and the 61 years or above category comprised 5.38% of the academics [71]. Approximately 3300 permanent academic members are employed in the Sri Lankan higher education sector, in fifteen state and seven non-state universities [72]. In this study, the researchers only included permanent academic members employed full time in respective universities, in lecturer positions and above and therefore excluded visiting lecturers and those working on a contract basis. The authors developed a structured questionnaire and distributed the online survey among all scholastic members of Sri Lankan universities. The subsequent sections respectively discuss data collection, sampling technique, and analytical framework, concluding with the results.

Each individual voluntarily participated and could refuse their participation at any time without being discriminated or penalised. Hence, in the data collection process, the researchers adopted a sampling technique free of bias, and aimed to obtain around 346 responses from the academics in Sri Lankan HEIs from the target population of approximately 3300 academics [73]. A pilot study with 30 participants was conducted during May 2021 to find out whether questions were understandable, clear and presented in a logical manner. The on-

line survey of the current study was conducted during June-September 2021 and terminated receiving 337 usable responses with a representative sample of population parameters.

Analytical Framework

We estimated multiple regression models to test our hypotheses. The academic members' attitudes towards WFH is a function of their dominant orientation, and the baseline model is specified as follows:

$$WFH_i = \beta_0 + \beta_1 OTT_i + \beta_2 OTRSC_i + \beta_3 OTDOK_i + \beta_4 DM_i + \varepsilon_i \quad (1)$$

where WFH_i is attitude indicator towards *WFH* of *i*th academic member; $OTT_i, OTRSC_i$, $OTDOK_i$ are orientation towards teaching; orientation towards research, scholarly and creative works; and orientation towards dissemination of knowledge, respectively; DM_i indicates control dummy variables relevant to *i*th academic member; ε_i denotes the random error term at the individual level. Further, alternative multiple regression models with different specifications were estimated to check the robustness of the baseline results. Accordingly, in model 2, we included an array of socio-demographic variables to control their effects, while in model 3 we excluded the academic members attached to universities' management faculties from the sample. The majority of academic members were from management faculties, and we needed to ascertain whether they made a significant influence on the baseline results. Furthermore, model (4) developed including subject areas with more practical orientation/component (Engineering, Medical and Technology) to explore the academics' attitude towards WFH with the changes of discipline with more practical orientation.

4. Results

4.1. Descriptive Statistics

Table A1 under the Appendix A presents descriptive statistics of the main study variables. Accordingly, the academic members belong to a diverse group in terms of their age, and they are approximately equally distributed between the two gender groups. The majority is having a PhD degree as the maximum educational attainment (51.93%) while the majority represents public sector universities (83.38%). Although we consider academic members from various faculties, 40.35% of the sample represents management or business faculties in Sri Lankan universities.

The independent variables of the model are: OTT which measures academics orientation towards teaching; OTRSC measures the academics' orientation towards research and scholarly works; OTDOK captures the academics' orientation towards dissemination of knowledge. All these three independent variables' scales were developed based on the University Grants Commission (UGC) circulars on academic performance evaluations in the Sri Lankan higher education sector. The index values of OTT range from 1.5 to 4.75 with a mean of 3.127 and a standard deviation of 0.513, while OTRSC ranges from 1.571 to 4.071 with a mean of 2.888 and a standard deviation of 0.480. OTRSC ranges from 1 to 4 with a mean of 1.737 while standard deviation is 0.664 (see Table 1).

Table 1. Descriptive statistics of main independent and dependent variables.

Variables	*N*	*Mean*	*s.d.*	*Min*	*Max*	*Sum_w*	*Var*	*Skewness*	*Kurtosis*	*Sum*
WFH	337	3.568	0.585	2	5	337	0.342	0.284	3.036	1203
OTT	337	3.127	0.513	1.500	4.750	337	0.263	−0.285	3.307	1054
OTRSC	337	2.888	0.480	1.571	4.071	337	0.230	0.117	3.435	973.2
OTDOK	337	1.737	0.664	1	4	337	0.441	1.029	3.748	585.4

Source: Authors' calculations.

The dependent variable of our model is WFH which measures academic's attitudes towards WFH. We used the scale developed by Almaghaslah & Alsayari (2020) to measure

attitudes towards WFH, including 10 questionnaire items. The sample items include 337 responses. As shown in the Table 1, the index value of WFH ranges from 2 to 5, with a mean value of 3.568 and a standard deviation of 0.585. The Alpha value of 0.8297 (see Table 2) indicates that the measure is internally consistent with an adequate degree of reliability.

Table 2. Cronbach's alpha values of main study variables.

Variable	Reliability (Cronbach's Alpha)	Number of Items
OTT	0.7812	12
OTRSC	0.7320	14
OTDOK	0.9234	13
WFH	0.8297	10

Source: Authors' calculations.

4.2. Reliability Results

The reliable and accurate information allowed researchers to bring a fruitful analysis. Furthermore, reliable measures ensured that our main latent constructs were internally consistent. We used Cronbach's Alpha value of each latent construct to determine the internal consistency of composite measures. Accordingly, the Alpha values for the variables of OTT, OTRSC and OTDOK are reported in Table 2. The Alpha values of the three independent variables are higher than 0.7 (see Table 2), indicating that the measures are internally consistent with an adequate degree of reliability.

4.3. Baseline Regression Results and Robustness Checks

In the data analysis, multiple linear regressions were applied model (1) including the main study variables; model (2) includes main variables along with dummy variables; model (3) demonstrates the regression model with specification test for robustness checks; finally, Model (4) shows the regression results with academics from more practical oriented disciplines (engineering, medical and technology).

The model specification tests were conducted to examine the fit across alternative models. For instance, multicollinearity was checked using Variance Inflation Factor (VIF) and tolerance to assure the independent variables were free from intercorrelation with each other. Our estimations showed that age and experience were strongly correlated, presenting a reasonable degree of multicollinearity. To rectify the issue, we dropped age from the dummy variables list and kept experience in the final model. After removing age as a dummy variable, the regression was rerun and we observed that VIF and tolerance were low; maximum VIF level was 1.99 and maximum tolerance level was 0.9601, suggesting that multicollinearity is not a crucial issue in this study.

To satisfy the regression assumptions and to improve further the trust in the regression results, heteroscedasticity was checked to assure that all residuals were drawn from a population with a constant variance (homoscedasticity). Our results concluded that the error term is homoscedastic in the model (Prob > F = 0.8040, $p < 0.05$). Moreover, the significant variables were checked using the forward stepwise regression technique, allowing 5% error level for hypothesis testing. The model's fit was assessed using a developed overall goodness-of-fit metric; the model with the highest goodness-of-fit value was chosen for this evaluation.

Table 3 presents baseline regression results and the results of the three alternative models. As shown in Table 3, academics with predominantly teaching-orientation have positive attitudes towards WFH (B = 0.365, $p < 0.01$). Accordingly, a high level of teaching-orientation significantly increases the index value of attitudes towards WFH. Even after controlling for an array of socio-demographic including age, gender, level of education, experience, university sector, and research interests, the results in terms of the direction of their relationship remain the same (B = 0.347, $p < 0.01$). Then, to check whether management or business faculties have a significant influence on the baseline results, we estimated an

alternative model excluding academics from management and business faculties. According to Table 3, the baseline results remained the same (B = 0.490, $p < 0.01$) in such a way that when the index value for teaching-orientation increases, the index of attitudes towards WFH also significantly increases, implying positive attitudes towards WFH. However, after incorporating model (4) using academics from the disciplines of engineering, medicine and technology, the results show that the academics with predominantly teaching orientation have negative attitudes (B = −0.0490, $p > 0.1$) towards WFH, though the relationship is not statistically significant. Hence, it can be concluded that those who are involved in teaching and researching more practically oriented modules show less preference for the concept of WFH.

Table 3. Regression results-on variables.

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)
Gender		0.0300	0.128 *	0.130
		(0.0584)	(0.0725)	(0.0872)
Education		−0.116 ***	−0.0850 **	−0.0588
		(0.0324)	(0.0378)	(0.0392)
Experience		−0.000520	−0.0757 ***	−0.0669 **
		(0.0211)	(0.0257)	(0.0308)
University Sector		0.0434	0.0115	0.0711
		(0.0743)	(0.117)	(0.136)
Research Interest		−0.0321	0.156 *	0.205 *
		(0.0640)	(0.0887)	(0.116)
OTT	0.365 ***	0.347 ***	0.490 ***	−0.0490
	(0.0657)	(0.0599)	(0.0804)	(0.120)
OTRSC	0.339 ***	0.345 ***	0.320 ***	0.581 ***
	(0.0699)	(0.0703)	(0.0859)	(0.102)
OTDOK	−0.294 ***	−0.242 ***	−0.198 ***	−0.525 ***
	(0.0421)	(0.0497)	(0.0604)	(0.0777)
Constant	1.957 ***	2.248 ***	1.824 ***	3.176 ***
	(0.185)	(0.213)	(0.287)	(0.360)
Observations	337	337	201	86
R-squared	0.249	0.293	0.394	0.546

Note: Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations.

According to Table 3, the academics with predominantly research-orientation have positive attitudes to WFH (B = 0.339, $p < 0.01$). Hence, a high level of research-orientation significantly increases the index value of attitudes towards WFH. After controlling for an array of socio-demographics as mentioned above, the results in terms of the direction of their relationship remain the same (B = 0.345, $p < 0.01$). Moreover, we estimated an alternative model excluding academics from management and business faculties since the majority of the sample items were from the same discipline. Even after excluding these variables, the baseline results remained the same (B = 0.320, $p < 0.01$). In addition, we estimated another model including academics from engineering, medical and technology-related disciplines. The results remained comparatively similar (B = 0.581, $p < 0.01$) to the baseline results. Therefore, when the index value for research-orientation increases, the index of attitudes towards WFH also significantly increases, implying positive attitudes towards WFH.

The academics with predominantly practitioner-orientation have negative attitudes to WFH (B = −0.294, $p < 0.01$), indicating that increased dissemination-of-knowledge-orientation significantly decreases the index value of attitudes towards WFH. It is noticeable

when controlling for an array of socio-demographic variables (see Table 3), the results in terms of the direction of their relationship remain the same (B = −0.242, $p < 0.01$). In addition, based on the alternative model excluding academics from management and business faculties, the baseline results remain the same (B = −0.198, $p < 0.01$). Furthermore, as per model (4) including academics from engineering, medical and technology-related disciplines, the baseline results remain the same (B = −0.525, $p < 0.01$). Accordingly, when the index value for practitioner-orientation decreases, the index of attitudes towards WFH also significantly decreases, implying negative attitudes towards WFH.

5. Discussion

Multiple linear regression models were used in the data analysis: model (1) included the main research variables, and model (2) included key variables as well as dummy variables, model (3) showed a regression model with a specification test to ensure its robustness. The regression findings from academics who come from more practical related disciplines are shown in the final model (4).

As per the first model, significant ($p < 0.01$) positive signs are available from more teaching and research-oriented academics towards the concept of WFH, while more practitioner-oriented academics showed a significant ($p < 0.01$) negative attitude to the concept of WFH. These results achieved the study objectives by identifying how different types of academics perceived the WFH concept amidst a pandemic and even beyond. Similarly, model (2) was developed by including dummy variables for certain control variables (gender, experience in years as an academic, highest educational qualification, university sector and their primary research interest), and they finally confirm the same sign of coefficients with a significant ($p < 0.01$) influence towards the favourable perception of the WFH concept. To achieve a reliable and accurate outcome, models (3) and (4) were constructed to check the robustness of results. As per the results, very similar results were generated regarding the main study variables, confirming the baseline results obtained from models (1) and (2). However, model (4) deviates from the results and generated a non-significant negative sign between teaching orientation and academics' attitude towards the concept of WFH. This result aligns with the previous studies conducted by Lambert & Schuck (2021), which found that as opposed to teaching highly theoretical disciplines, online teaching disciplines have a lot of practical components, which makes the task more difficult. Ashokka et al. (2020) stated that medical education must be delivered in decentralized manner and in modes enabled by advanced technology if it is to be sustained.

Previous studies discussed perspectives of online teaching, and revealed flexibility and timesaving when delivering teaching content online compared to physical sessions [74]. Hence, students too enjoyed online delivery with more questions and clarifications in the excess time. According to a study conducted in a Lithuanian university on students' attitudes to online learning environments based on favourable and unfavourable factors, those students gained more experience and became more familiar with the online learning environment with online learning practice. Hence, their resistance to using online learning platforms declined gradually and they successfully adapted to the system emphasising the favourable side of practising hybrid learning. However, during this process, the teacher has to play a bigger role as a mentor [75]. Another study assessed whether hybrid sports education could be more effective for less motivated students. The findings of that study suggested that a hybrid sports education teaching unit may be an effective pedagogical resource to improve students' motivational processes. Similarly, hybridisation of student-centred pedagogical models enables more favourable exposure to physical education sessions for all students [76].

Evaluating postgraduate students' perceptions of hybrid learning environments for business education in the context of Hong Kong Polytechnic University, a study revealed that "online learning is especially becoming a popular way of delivering courses in business education and a subject of interest in academic literature" [77]. Furthermore, the presence of industry speakers through virtual guest lectures and sessions arranged with the

participation of professors from abroad aided the internationalisation of the curriculum. In addition, the same study pointed out that students were able to enhance their independent learning capacities with the usage of various digital tools [77]. Another empirical study examined future preference for e-learning among undergraduates during the closure of HEIs in the Malaysian context. This study described how undergraduates shifted their attitudes toward e-learning activities from resistance to preference, and how undergraduates missed the advantages of e-learning when they returned to traditional face-to-face learning. Therefore, they requested hybrid learning or blended learning which combines the best of both worlds [78]. One of the studies in the context of Chinese universities found that university students were highly satisfied with the online learning platforms [79].

Moreover, Zhu & Liu (2020) emphasised the same idea and stated that this situation will open paths to quality access to education. The current study aligns with these previous studies. Performing teaching and research activities while staying at home minimises traffic congestion, pollution, and time wasted on travelling [74]. A study conducted in the Indonesian context based on one of the state sector universities investigated student impressions of the shift from offline to online instruction. The findings revealed that students embraced online learning adoption because they perceived online learning to be more flexible, efficient, and effective in terms of time, cost, and energy [80]. Aligning with the current study's model (4) observations, previous studies also indicated that nursing students have a favourable attitude to online learning. Students are delighted with the learning possibilities through online education during COVID-19. However, interrupted internet connections, unfeasible practical-natured courses, load-shedding, and other factors were seen as roadblocks to online learning. Positive perceptions were influenced by age, nursing program enrolment, academic year, and gadgets used [81]. According to Ayurveda students' perception of online learning, they appreciated online learning during the pandemic period and require a combination of both learning modalities in future to cover practical exposure in a better way [82].

However, Akour et al. (2020) revealed that continuous WFH may have effects on academics' psychological health and work-life balance. Therefore, it is essential that when formulating policies, policymakers determine the best WFH models by considering the overall impact on the teaching–learning process and its key stakeholders. As the main stakeholders, students also found certain drawbacks and reasons for reduced preference for online learning methods. The impact of online learning from students' and teachers' perspectives was studied by collecting data from colleges and universities in Bangalore city, India. The study found that, in terms of social presence, engagement, contentment, and overall quality, face-to-face learning is preferred over online learning. Even while online classes were said to be more convenient in terms of saving time, both professors and students thought these were less productive and structured than traditional classroom learning. Technical support was discovered to be a crucial component in determining student satisfaction with online classes [83]. According to postgraduate students' perspectives of learning from home in the context of an Indonesian graduate school, the researchers accepted that understanding the scope of e-learning can give a positive colour to the world of education delivery. This occurs by removing boundaries of time and space so that everybody can receive adequate teaching. However, they expressed concerns that limited internet network and other technological problems can ruin online lecturing [84].

Further, academics' engagement with foreign research collaborations has been improved tremendously by WFH [60]. This offers much potential and opportunities for a country like Sri Lanka, as a developing nation, to achieve greater outcomes in this field of research [60,61]. When performing the role of a global scientist, location is not vital, but online tools may play a crucial role. Therefore, when making policy decisions on WFH, it is mandatorily required to provide technological infrastructure appropriately. However, in model (3) and model (4), research interest shows a slightly significant ($p < 0.1$) impact on WFH. The majority of respondents depended on field data. Particularly when conducting research in the domains of IT, Science, Engineering and Medicine, academics require

different aspects to be considered when compared to research studies in social sciences. Moreover, novel platforms in the new normal environment strengthen researchers in a sustainable way by removing barriers to physical representation [60].

Moreover, academics showed a significant ($p < 0.01$) negative association with the role of the practitioner when WFH. Though previous studies stressed the disadvantages of WFH, the new normal environment allows researchers to share international level best practices and expertise at the local level [58]. Developing countries acquired greater foreign exposure by inviting foreign academics to local academic conferences during the pandemic using online platforms [62]. In this process, Sri Lankan academics received relatively fewer invitations for sharing knowledge as keynote speakers compared to the pre-pandemic situation, hence, the opportunities were adequately enjoyed by the scholars in more affluent contexts in terms of technology. Accordingly, policymakers should broaden opportunities for local academics to duly share their scientific knowledge and experience, to aid for decision-making in respective countries. Cole (2020) mentioned the necessity of enhancing effective relationships with different stakeholders, since academics need to continue their knowledge dissemination roles during any crisis.

Additionally, among dummy variables, experience showed a significant ($p < 0.01$) negative impact on WFH. Accordingly, less experienced academics in Sri Lankan universities have relatively less motivation to WFH while experienced academics showed their willingness and the ability to cope with the technological tools. Based on model (2), educational qualification had a significant negative ($p < 0.01$) impact according to the results. Hence, matured and highly qualified academics have less motivation to WFH and younger academics with bachelors and masters qualifications have motivation to WFH. However, in model (3), after removing management faculty respondents, gender becomes a slightly significant ($p < 0.1$) factor when performing duties at home. This is applicable for academics who represent IT, humanities and social sciences, science, engineering, medical and other faculties. Recent studies have also emphasised that when WFH, potential negative impacts can occur for females' career prospects. The possible reason is that female academic members are normally double-burdened when they are at home with household activities along with academic-related activities like research [3,35–37].

Although, as Rodrigues et al. (2021) emphasised, there were negative psychological feelings towards WFH among academics at first, teleworking has shown positive signs of continuing even in the new normal environment for the betterment of social, economic and environmental pillars. Hence, there is a fairly high chance of embracing WFH in the new normal environment even beyond the pandemic [85], since WFH will be a win-win solution for some organisations during the crisis and beyond, especially for highly educated workers [86]. Academics have more opportunities to enjoy a more productive work model by adopting the best practices of the WFH concept.

6. Implications and Limitations

While online technology has demonstrated certain flaws in terms of the smooth functioning of higher education processes during COVID-19, it has also provided a variety of novel concepts to help higher education systems in a range of methods [87–89]. Without the insight of academics who are employed in HEIs island-wide the action plan may fail. Therefore, the current study provides significant input from academics' viewpoints as well as from students' insights. Based on the existing literature about preference towards the hybrid work model linked with WFH and learning from home for performing teaching and learning, research activities are seen to be at a better level compared to the dissemination of knowledge.

In accordance with findings of previous studies, researchers argue that a heterogeneous higher education system may fail to contribute significantly to the development of human capital theory [88,90–92]. Sri Lanka also faces the problem of heterogeneity in the higher education system [93] and it is necessary to find a solution for reducing heterogeneity in the system.

According to the findings of previous studies conducted in a variety of settings prior to and during the pandemic, modern technological developments such as computer-aided learning, online education, and social media can supplement "instructional technology" and help to lessen the heterogeneity of systems affecting higher education [94–98]. Therefore, as a developing country, Sri Lanka can obtain the benefits of online technology to minimise heterogeneity in the higher education system. In a study conducted by Alam & Parvin (2021) in the context of the Asian country of Bangladesh, researchers were able to create a policy framework that encourages the use of online technology to provide higher education. Hence, it is proven that the applicability of using online technology for delivering higher education extends beyond the pandemic.

Use of cutting-edge technical breakthroughs are especially well-suited to higher education in times of crisis [88]. Therefore, higher education should be able to play a positive role in bringing about real social change as a result of technical advancements. It can do so by reducing the discrimination that is so prevalent in developing countries' societies. Moreover, Alam & Parvin (2021) highlighted that many developing countries may not be able to fully use their technical competitive advantages, particularly in higher education, due to a variety of political, economic, cultural, and traditional obstacles.

However, a study conducted in Bangladesh proposes an application-driven regulatory framework to ensure the viability of higher education during an emergency [99]. The same study emphasized that the introduced regulatory framework may require ongoing revisions, and that its application is critical to ensuring adequate higher education functionality during an emergency. Similarly, the current study also supports improvement of the regulatory framework for developing countries, considering the lessons learned during the pandemic to establish an appropriate regulatory framework beyond the pandemic.

As a result, Sri Lanka is well placed to gain the benefits of hybrid university practices by introducing an effective policy to employ the advantages of both online and offline worlds beyond the pandemic, rather than shifting towards a fully physical environment, getting the maximum out of the technological revolution introduced during the world largest educational crisis amidst the COVID-19 pandemic. Teachers and students can provide their support for the recommended hybrid methods which were not available when restricted to a single system. Generally, students and teachers are diverse in nature, hence a hybrid solution can meet each party's requirements while minimizing disruptions caused by uncertainties or pandemics in future.

The current study scope was limited to research about university academics' viewpoints and their attitudes towards WFH amidst the pandemic and beyond. Collecting a huge amount of data from a field survey with university students to check their attitudes towards learning from home was not possible due to the minimal funds available for this study. Hence, further research should be conducted to explore institutional and students' readiness to accept proposed hybrid methods in the higher education system. Apart from that, the current study assumed linearity when developing regression models, and therefore, our models do not capture non-linear impacts of covariates on the dependent variable of interest. Thus, a future study may estimate quadratic regression models to discover non-linear relationships among variables. Furthermore, the findings and analysis were based on quantitative responses obtained from participants via online questionnaires using Google Forms. Future research may be able to combine qualitative evidence along with quantitative evidence to provide more robust and triangulated results. Despite these limitations, the current study has provided valuable insights into Sri Lanka's higher education policy predicament.

7. Conclusions

This study is one of the first attempts to examine academics' attitudes towards the WFH concept when performing different roles as an academic. The major findings of this research emphasise that there is a significant positive attitude among academics towards online teaching and researching while WFH. The findings also imply that there is

a significant negative attitude towards WFH when disseminating knowledge and being involved in community services with various stakeholders. Overall, for an academic, there is an opportunity to continue working with the hybrid work model in an effective way, even beyond the pandemic.

The current study findings deviate from those of the previous studies; it provides a pragmatic and convenient approach to recognising the impact of different types of academics based on their dominant orientations and their attitude towards the WFH concept, especially with unique results for developing nations like Sri Lanka. Furthermore, the present study provides a better path for universities' regulatory bodies to determine different work platforms with appropriate resource allocation. This type of approach using a successful hybrid working model will be a significant solution to the harmful impacts of economic downturn conditions. Moreover, considering academics' and students' points of view on the online and offline worlds of education, they now seek a blended model in the new normal. As such, this study opens the path for introducing an effective work model for academics while improving learners' satisfaction in an optimum way. Hence, this study provides input for policymakers to implement effective policies to recover from economic setbacks and improve the satisfaction of learners and teachers in the higher education system.

In developing countries, the main barriers to improving the quality of education include poor infrastructure facilities and limited accessibility. With the digital revolution, the switch from physical work to online platforms has created plausible causes for optimism, broadening the horizon with several opportunities. Hence, the pandemic was a blessing, 'the silver lining in the cloud', and has opened a path to success for the majority of developing nations receiving exposure to the best global practices and knowledge shared with the rest of the world. Hence, developing countries should have effective policies in place to create hybrid teaching and learning methods to realise the optimum from the lessons learned. For many developing countries, this online experience has helped climb towards accomplishing the fourth sustainable development goal, quality education by 2030. Subsequently, in the new normal environment, a hybrid working model may be introduced by realising the essence of WFH based on different types of academic orientations and their favourable perceptions of the WFH model, rather than returning to a full physical academic working environment.

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Appendix A

Table A1. General description of the demographics.

Demographics	Categories	N	Percentage (%)
Age	25–30 Years	64	18.99
	31–35 Years	56	16.62
	36–40 Years	37	10.98
	41–45 Years	62	18.40
	46–50 Years	45	13.35
	51–55 Years	43	12.76
	56 and above years	30	8.90
Gender	Male	165	48.96
	Female	172	51.04
Highest Educational Qualification	Bachelors	34	10.09
	Masters	105	31.16
	MPhil	17	5.04
	PhD	175	51.93
	DSC	6	1.75
Experience as an academic	0–5 Years	99	29.38
	6–10 Years	58	17.21
	11–15 Years	41	12.17
	16–20 Years	60	17.80
	21–25 Years	52	15.43
	26–30 Years	7	2.08
	31 and above years	20	5.93
University Sector	Public	281	83.38
	Private	56	16.62
Faculty	Management/Business	136	40.35
	Humanities and Social Science	43	12.75
	IT/Computing/Technology	33	9.79
	Engineering	35	10.38
	Science	45	13.35
	Medical	18	5.34
	Other	27	8.04
Primary Research Interest	Field Survey	236	70.03
	Secondary Data	101	29.97
Total		337	100.0

Source: Authors' calculations.

References

1. Afrianty, T.W.; Artatanaya, I.G.; Burgess, J. Working from home effectiveness during COVID-19: Evidence from university staff in Indonesia. *Asia Pac. Manag. Rev.* **2021**, *27*, 50–57. [CrossRef]
2. Alipour, J.-V.; Fadinger, H.; Schymik, J. My home is my castle–The benefits of working from home during a pandemic crisis. *J. Public Econ.* **2021**, *196*, 104373. [CrossRef]

3. Arntz, M.; Ben Yahmed, S.; Berlingieri, F. Working from Home and COVID-19: The Chances and Risks for Gender Gaps. *Intereconomics* **2020**, *55*, 381–386. [CrossRef] [PubMed]
4. Bao, L.; Li, T.; Xia, X.; Zhu, K.; Li, H.; Yang, X. How does working from home affect developer productivity?—A case study of Baidu during the COVID-19 pandemic. *Sci. China Inf. Sci.* **2022**, *65*, 1–15. [CrossRef]
5. Okuyan, C.B.; Begen, M.A. Working from home during the COVID-19 pandemic, its effects on health, and recommendations: The pandemic and beyond. *Perspect. Psychiatr. Care* **2021**, *58*, 173–179. [CrossRef]
6. Bolisani, E.; Scarso, E.; Ipsen, C.; Kirchner, K.; Hansen, J.P. Working from home during COVID-19 pandemic: Lessons learned and issues. *Manag. Mark. Chall. Knowl. Soc.* **2020**, *15*, 458–476. [CrossRef]
7. Chung, H.; Seo, H.; Forbes, S.; Birkett, H. *Working from Home during the COVID-19 Lockdown: Changing Preferences and the Future of Work*; University of Kent: Canterbury, UK, 2020; p. 39.
8. Dockery, M.; Bawa, S. *Working from Home in the COVID-19 Lockdown: Transitions and Tensions*; Bankwest Curtin Economics Centre: Bentley, Australia, 2020.
9. Georgiadou, A.; Mouzakitis, S.; Askounis, D. Working from home during COVID-19 crisis: A cyber security culture assessment survey. *Secur. J.* **2021**, *9*, 1–20. [CrossRef]
10. Gottlieb, C.; Grobovšek, J.; Poschke, M. Working from home across countries. *COVID Econ.* **2020**, *1*, 71–91.
11. Guler, M.A.; Guler, K.; Gulec, M.G.; Ozdoglar, E. Working from Home During a Pandemic: Investigation of the Impact of COVID-19 on Employee Health and Productivity *J. Occup. Environ. Med.* **2021**, *63*, 731–741. [CrossRef]
12. Hallman, D.M.; Januario, L.B.; Mathiassen, S.E.; Heiden, M.; Svensson, S.; Bergström, G. Working from home during the COVID-19 outbreak in Sweden: Effects on 24-h time-use in office workers. *BMC Public Health* **2021**, *21*, 528. [CrossRef]
13. Hayes, S.; Priestley, J.L.; Ishmakhametov, N.; Ray, H.E. "I'm not Working from Home, I'm Living at Work": Perceived Stress and Work-Related Burnout before and during COVID-19. *PsyArXiv* **2020**, *103*, 2391–2399. [CrossRef]
14. McDowell, C.P.; Herring, M.P.; Lansing, J.; Brower, C.; Meyer, J.D. Working from Home and Job Loss Due to the COVID-19 Pandemic Are Associated with Greater Time in Sedentary Behaviors. *Front. Public Health* **2020**, *8*, 597619. [CrossRef] [PubMed]
15. Moretti, A.; Menna, F.; Aulicino, M.; Paoletta, M.; Liguori, S.; Iolascon, G. Characterization of Home Working Population during COVID-19 Emergency: A Cross-Sectional Analysis. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6284. [CrossRef] [PubMed]
16. Mustajab, D.; Bauw, A.; Rasyid, A.; Irawan, A.; Akbar, M.A.; Hamid, M.A. Working from Home Phenomenon as an Effort to Prevent COVID-19 Attacks and Its Impacts on Work Productivity. *Int. J. Appl. Bus.* **2020**, *4*, 13–21. [CrossRef]
17. Raišienė, A.G.; Rapuano, V.; Varkulevičiūtė, K.; Stachová, K. Working from Home—Who is Happy? A Survey of Lithuania's Employees during the COVID-19 Quarantine Period. *Sustainability* **2020**, *12*, 5332. [CrossRef]
18. Rysavy, M.D.T.; Michalak, R. Working from Home: How We Managed Our Team Remotely with Technology. *J. Libr. Adm.* **2020**, *60*, 532–542. [CrossRef]
19. Almaghaslah, D.; Alsayari, A. The Effects of the 2019 Novel Coronavirus Disease (COVID-19) Outbreak on Academic Staff Members: A Case Study of a Pharmacy School in Saudi Arabia. *Risk Manag. Health Policy* **2020**, *13*, 795–802. [CrossRef]
20. World Bank-Higher Education for the Twenty First Century Project & University Grants Commission. Induction Program for Academic Staff of Sri Lankan Universities—Training Manual. University Grants Commission Sri Lanka. 2012. Available online: https://www.ugc.ac.lk (accessed on 22 March 2022).
21. Mseleku, Z. A Literature Review of E-Learning and E-Teaching in the Era of COVID-19 Pandemic. *Int. J. Innov. Sci. Res. Technol.* **2020**, *5*, 10.
22. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med.* **2009**, e1000097. [CrossRef]
23. Drašler, V.; Bertoncelj, J.; Korošec, M.; Žontar, T.P.; Ulrih, N.P.; Cigić, B. Difference in the Attitude of Students and Employees of the University of Ljubljana towards Work from Home and Online Education: Lessons from COVID-19 Pandemic. *Sustainability* **2021**, *13*, 5118. [CrossRef]
24. Filho, W.L.; Wall, T.; Rayman-Bacchus, L.; Mifsud, M.; Pritchard, D.J.; Lovren, V.O.; Farinha, C.; Petrovic, D.S.; Balogun, A.-L. Impacts of COVID-19 and social isolation on academic staff and students at universities: A cross-sectional study. *BMC Public Health* **2021**, *21*, 1213. [CrossRef]
25. Kniffin, K.M.; Narayanan, J.; Anseel, F.; Antonakis, J.; Ashford, S.P.; Bakker, A.B.; Bamberger, P.; Bapuji, H.; Bhave, D.P.; Choi, V.K.; et al. COVID-19 and the workplace: Implications, issues, and insights for future research and action. *Am. Psychol.* **2021**, *76*, 63–77. [CrossRef] [PubMed]
26. Barbieri, T.; Basso, G.; Scicchitano, S. Italian Workers at Risk during the COVID-19 Epidemic. *Ital. Econ. J.* **2021**, *8*, 175–195. [CrossRef]
27. Ekpanyaskul, C.; Padungtod, C. Occupational Health Problems and Lifestyle Changes Among Novice Working-From-Home Workers Amid the COVID-19 Pandemic. *Saf. Health Work* **2021**, *12*, 384–389. [CrossRef]
28. Hashim, R.; Bakar, A.; Noh, I.; Mahyudin, H.A. Employees' Job Satisfaction and Performance through working from Home during the Pandemic Lockdown. *Environ. Behav. Proc. J.* **2020**, *5*, 461–467. [CrossRef]
29. Kotera, Y.; Green, P.; Rhodes, C.; Williams, A.; Chircop, J.; Spink, R.; Rawson, R.; Okere, U. Dealing with Isolation Using Online Morning Huddles for University Lecturers During Physical Distancing by COVID-19: Field Notes. *Int. Rev. Res. Open Distrib. Learn.* **2020**, *21*, 238–244. [CrossRef]

30. Parola, A. Novel Coronavirus Outbreak and Career Development: A Narrative Approach into the Meaning for Italian University Graduates. *Front. Psychol.* **2020**, *11*, 2255. [CrossRef]
31. Roh, T.; Moreno-Rangel, A.; Baek, J.; Obeng, A.; Hasan, N.T.; Carrillo, G. Indoor Air Quality and Health Outcomes in Employees Working from Home during the COVID-19 Pandemic: A Pilot Study. *Atmosphere* **2021**, *12*, 1665. [CrossRef]
32. Smyth, C.; Cortis, N.; Powell, A. University staff and flexible work: Inequalities, tensions and challenges. *J. High. Educ. Policy Manag.* **2020**, *43*, 489–504. [CrossRef]
33. Vyas, L.; Butakhieo, N. The impact of working from home during COVID-19 on work and life domains: An exploratory study on Hong Kong. *Policy Des. Pract.* **2020**, *4*, 59–76. [CrossRef]
34. Waizenegger, L.; McKenna, B.; Cai, W.; Bendz, T. An affordance perspective of team collaboration and enforced working from home during COVID-19. *Eur. J. Inf. Syst.* **2020**, *29*, 429–442. [CrossRef]
35. Couch, D.L.; O'Sullivan, B.; Malatzky, C. What COVID-19 could mean for the future of "work from home": The provocations of three women in the academy. *Gend. Work. Organ.* **2020**, *28*, 266–275. [CrossRef]
36. Guy, B.; Arthur, B. Academic motherhood during COVID-19: Navigating our dual roles as educators and mothers. *Gender, Work Organ.* **2020**, *27*, 887–899. [CrossRef] [PubMed]
37. Yamamura, E.; Tsustsui, Y. The impact of closing schools on working from home during the COVID-19 pandemic: Evidence using panel data from Japan. *Rev. Econ. Househ.* **2021**, *19*, 41–60. [CrossRef]
38. Nash, M.; Churchill, B. Caring during COVID-19: A gendered analysis of Australian university responses to managing remote working and caring responsibilities. *Gender Work Organ.* **2020**, *27*, 833–846. [CrossRef]
39. Utoft, E.H. 'All the single ladies' as the ideal academic during times of COVID-19? *Gend. Work Organ.* **2020**, *27*, 778–787. [CrossRef]
40. Galanti, T.; Guidetti, G.; Mazzei, E.; Zappalà, S.; Toscano, F. Work from Home During the COVID-19 Outbreak: The Impact on Employees' Remote Work Productivity, Engagement and Stress. *J. Occup. Environ. Med.* **2021**, *63*, e426–e432. [CrossRef]
41. Toniolo-Barrios, M.; Pitt, L. Mindfulness and the challenges of working from home in times of crisis. *Bus. Horiz.* **2021**, *64*, 189–197. [CrossRef]
42. Wolor, C.W.; Dalimunthe, S.; Febrilia, I.; Martono, S. How to Manage Stress Experienced by Employees When Working from Home Due to the COVID-19 Virus Outbreak. *Int. J. Adv. Sci. Tech-Nology* **2020**, *29*, 7.
43. Xiao, Y.; Becerik-Gerber, B.; Lucas, G.; Roll, S.C. Impacts of Working from Home during COVID-19 Pandemic on Physical and Mental Well-Being of Office Workstation Users. *J. Occup. Environ. Med.* **2021**, *63*, 181–190. [CrossRef]
44. Purwanto, A.; Asbari, M.; Fahlevi, M.; Mufid, A.; Agistiawati, E.; Cahyono, Y.; Suryani, P. Impact of Work from Home (WFH) on Indonesian Teachers Performance During the COVID-19 Pandemic: An Exploratory Study. *Int. J. Adv. Sci. Technol.* **2020**, *29*, 11.
45. Ipsen, C.; van Veldhoven, M.; Kirchner, K.; Hansen, J.P. Six Key Advantages and Disadvantages of Working from Home in Europe during COVID-19. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1826. [CrossRef] [PubMed]
46. Alhumaid, K.; Ali, S.; Waheed, A.; Zaheed, E.; Habes, M. COVID-19 & Elearning: Perceptions &Attitudes of Teachers Towards E-Learning Acceptance in The Developing Countries. *Multicult. Educ.* **2020**, *6*, 100–115. [CrossRef]
47. Zhu, X.; Liu, J. Education in and After COVID-19: Immediate Responses and Long-Term Visions. *Postdigit. Sci. Educ.* **2020**, *2*, 695–699. [CrossRef]
48. Pokhrel, S.; Chhetri, R. A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *High. Educ. Future* **2021**, *8*, 133–141. [CrossRef]
49. Xu, J. Chinese University Students' L2 Writing Feedback Orientation and Self-Regulated Learning Writing Strategies in Online Teaching During COVID-19. *Asia-Pac. Educ. Res.* **2021**, *30*, 563–574. [CrossRef]
50. Metscher, S.E.; Tramantano, J.S.; Wong, K.M. Digital instructional practices to promote pedagogical content knowledge during COVID-19. *J. Educ. Teach.* **2020**, *47*, 121–124. [CrossRef]
51. Scull, J.; Phillips, M.; Sharma, U.; Garnier, K. Innovations in teacher education at the time of COVID19: An Australian perspective. *J. Educ. Teach.* **2020**, *46*, 497–506. [CrossRef]
52. López, B. How Higher Education Promotes the Integration of Sustainable Development Goals—An Experience in the Postgraduate Curricula. *Sustainability* **2022**, *14*, 2271. [CrossRef]
53. Akour, A.; Al-Tammemi, A.B.; Barakat, M.; Kanj, R.; Fakhouri, H.N.; Malkawi, A.; Musleh, G. The Impact of the COVID-19 Pandemic and Emergency Distance Teaching on the Psychological Status of University Teachers: A Cross-Sectional Study in Jordan. *Am. J. Trop. Med. Hyg.* **2020**, *103*, 2391–2399. [CrossRef]
54. Lambert, R.; Schuck, R. "The Wall Now Between Us": Teaching Math to Students with Disabilities During the COVID Spring of 2020. *Asia-Pac. Educ. Res.* **2021**, *30*, 289–298. [CrossRef]
55. Ashokka, B.; Ong, S.Y.; Tay, K.H.; Loh, N.H.W.; Gee, C.F.; Samarasekera, D. Coordinated responses of academic medical centres to pandemics: Sustaining medical education during COVID-19. *Med Teach.* **2020**, *42*, 762–771. [CrossRef] [PubMed]
56. Bao, W. COVID-19 and online teaching in higher education: A case study of Peking University. *Hum. Behav. Emerg. Technol.* **2020**, *2*, 113–115. [CrossRef] [PubMed]
57. Garcez, A.; Silva, R.; Franco, M. Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda. *Educ. Inf. Technol.* **2021**, *27*, 1159–1182. [CrossRef] [PubMed]
58. Sleiwah, A.; Mughal, M.; Hachach-Haram, N.; Roblin, P. COVID-19 lockdown learning: The uprising of virtual teaching. *J. Plast. Reconstr. Aesthetic Surg.* **2020**, *73*, 1575–1592. [CrossRef]

59. Ghani, F. Peshawar Dental College Remote Teaching and Supervision of Graduate Scholars in the Unprecedented and Testing Times. *J. Pak. Dent. Assoc.* **2020**, *29*, S36–S42. [CrossRef]
60. Metcalfe, A.S.; Blanco, G.L. "Love is calling": Academic friendship and international research collaboration amid a global pandemic. *Emot. Space Soc.* **2021**, *38*, 100763. [CrossRef]
61. Lee, J.J.; Haupt, J.P. Scientific globalism during a global crisis: Research collaboration and open access publications on COVID-19. *High. Educ.* **2020**, *81*, 949–966. [CrossRef]
62. Rodrigues, M.; Silva, R.; Franco, M. Teaching and Researching in the Context of COVID-19: An Empirical Study in Higher Education. *Sustainability* **2021**, *13*, 8718. [CrossRef]
63. Rathnayake, R.M.N.M.; Kumarasinghe, P.J.; Kumara, A.S. The COVID-19 Pandemic and the Performance of Academic Personnel: An Open Access Systematic Literature Review Database (Version 1). *South Fla. J. Dev.* **2022**, *3*, 1367–1375. [CrossRef]
64. Chowdhry, A.; Kapoor, P.; Popli, D.B. Strengthening health care research and academics during and after COVID19 pandemic—An Indian perspective. *J. Oral Biol. Craniofacial Res.* **2020**, *10*, 343–346. [CrossRef] [PubMed]
65. Rashid, S.; Yadav, S.S. Impact of COVID-19 Pandemic on Higher Education and Research. *Indian J. Hum. Dev.* **2020**, *14*, 340–343. [CrossRef]
66. Raza, I.; Awang, Z. Knowledge sharing in multicultural organizations: Evidence from Pakistan. *High. Educ. Skills. Work.-Based Learn.* **2020**, *10*, 497–517. [CrossRef]
67. Lo, M.F.; Tian, F. How academic leaders facilitate knowledge sharing: A case of universities in Hong Kong. *Leadersh. Organ. Dev. J.* **2020**, *41*, 777–798. [CrossRef]
68. Arias Velásquez, R.M.A.; Mejía Lara, J.V. Knowledge management in two universities before and during the COVID-19 effect in Peru. *Technol. Soc.* **2020**, *64*, 101479. [CrossRef]
69. Chatterjee, S.; Rana, N.P.; Dwivedi, Y.K. Social media as a tool of knowledge sharing in academia: An empirical study using valance, instrumentality and expectancy (VIE) approach. *J. Knowl. Manag.* **2020**, *24*, 2531–2552. [CrossRef]
70. Cole, J. The COVID-19 infodemic: The role and place of academics in communicating science to the public. *arXiv* **2020**, arXiv:2011.08787.
71. University Grants Commission-Sri Lanka. *Sri Lanka University Statistics*; University Grants Commission: Colombo, Sri Lanka, 2020; pp. 101–107. Available online: https://www.ugc.ac.lk/index.php?option=com_content&view=article&id=2301%3Asri-lanka-university-statistics-2020&catid=55%3Areports&Itemid=42&lang=en (accessed on 22 March 2022).
72. Kumara, A.S.; Sachitra, V. Modeling the participation in physical exercises by university academic community in Sri Lanka. *Health Educ.* **2021**, *121*, 504–522. [CrossRef]
73. Krejcie, R.V.; Morgan, D.W. Determining Sample Size for Research Activities. *Educ. Psychol. Meas.* **1970**, *30*, 607–610. [CrossRef]
74. Dwivedi, Y.K.; Hughes, D.L.; Coombs, C.; Constantiou, I.; Duan, Y.; Edwards, J.S.; Gupta, B.; Lal, B.; Misra, S.; Prashant, P.; et al. Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *Int. J. Inf. Manag.* **2020**, *55*, 102211. [CrossRef]
75. Valantinaitė, I.; Sederevičiūtė-Pačiauskienė, Ž. The Change in Students' Attitude towards Favourable and Unfavourable Factors of Online Learning Environments. *Sustainability* **2020**, *12*, 7960. [CrossRef]
76. García-González, L.; Abós, A.; Diloy-Peña, S.; Gil-Arias, A.; Sevil-Serrano, J. Can a Hybrid Sport Education/Teaching Games for Understanding Volleyball Unit Be More Effective in Less Motivated Students? An Examination into a Set of Motivation-Related Variables. *Sustainability* **2020**, *12*, 6170. [CrossRef]
77. Pavlidou, I.; Dragicevic, N.; Tsui, E. A Multi-Dimensional Hybrid Learning Environment for Business Education: A Knowledge Dynamics Perspective. *Sustainability* **2021**, *13*, 3889. [CrossRef]
78. Looi, K.H.; Wye, C.-K.; Bahri, E.N.A. Achieving Learning Outcomes of Emergency Remote Learning to Sustain Higher Education during Crises: An Empirical Study of Malaysian Undergraduates. *Sustainability* **2022**, *14*, 1598. [CrossRef]
79. Jiang, H.; Islam, A.Y.M.A.; Gu, X.; Spector, J.M. Online learning satisfaction in higher education during the COVID-19 pandemic: A regional comparison between Eastern and Western Chinese universities. *Educ. Inf. Technol.* **2021**, *26*, 6747–6769. [CrossRef]
80. Firmansyah, R.; Putri, D.M.; Wicaksono, M.G.S.; Putri, S.F.; Widianto, A.A.; Palil, M.R. Educational Transformation: An Evaluation of Online Learning Due To COVID-19. *Int. J. Emerg. Technol. Learn.* **2021**, *16*, 61–76. [CrossRef]
81. Rana, S.; Garbuja, C.K.; Rai, G. Nursing Students' Perception of Online Learning Amidst COVID-19 Pandemic. *J. Lumbini Med. Coll.* **2021**, *9*, 6.
82. Sawarkar, G.; Sawarkar, P.; Kuchewar, V. Ayurveda students' perception toward online learning during the COVID-19 pandemic. *J. Educ. Health Promot.* **2020**, *9*, 342. [CrossRef]
83. Nambiar, D. The impact of online learning during COVID-19: Students' and teachers' perspective. *Int. J. Indian Psychol.* **2020**, *8*, 12. [CrossRef]
84. El Khuluqo, I.; Ghani, A.R.A.; Fatayan, A. Postgraduate students' perspective on supporting "learning from home" to solve the COVID-19 pandemic. *Int. J. Eval. Res. Educ.* **2021**, *10*, 615. [CrossRef]
85. Javad Koohsari, M.; Nakaya, T.; Shibata, A.; Ishii, K.; Oka, K. Working from Home After the COVID-19 Pandemic: Do Company Employees Sit More and Move Less? *Sustainability* **2021**, *13*, 939. [CrossRef]
86. Bonacini, L.; Gallo, G.; Scicchitano, S. Working from home and income inequality: Risks of a 'new normal' with COVID-19. *J. Popul. Econ.* **2020**, *34*, 303–360. [CrossRef] [PubMed]

87. Alam, G.M. Does online technology provide sustainable HE or aggravate diploma disease? Evidence from Bangladesh—A comparison of conditions before and during COVID-19. *Technol. Soc.* **2021**, *66*, 101677. [CrossRef] [PubMed]
88. Alam, G.M.; Parvin, M. Can online higher education be an active agent for change?—Comparison of academic success and job-readiness before and during COVID-19. *Technol. Forecast. Soc. Chang.* **2021**, *172*, 121008. [CrossRef]
89. Kim, C.; Feng, B. Digital inequality in online reciprocity between generations: A preliminary exploration of ability to use communication technology as a mediator. *Technol. Soc.* **2021**, *66*, 101609. [CrossRef]
90. Alam, G.M. Do Urbanized Socioeconomic Background or Education Programs Support Engineers for Further Advancement? *Int. J. Educ. Reform* **2021**, *30*, 344–360. [CrossRef]
91. Bruni, R.; Catalano, G.; Daraio, C.; Gregori, M.; Moed, H.F. Studying the heterogeneity of European higher education institutions. *Scientometrics* **2020**, *125*, 1117–1144. [CrossRef]
92. Marginson, S. Limitations of human capital theory. *Stud. High. Educ.* **2017**, *44*, 287–301. [CrossRef]
93. Herath, P.; Liyanage, K.; Ushiogi, M.; Muta, H. Analysis of Policies for Allocating University Resources in Het-erogeneous Social Systems: A Case Study of University Admissions in Sri Lanka. *High. Educ.* **1997**, *34*, 437–457. [CrossRef]
94. Dhir, A.; Chen, S.; Nieminen, M. The Effects of Demographics, Technology Accessibility, and Unwillingness to Communicate in Predicting Internet Gratifications and Heavy Internet Use Among Adolescents. *Soc. Sci. Comput. Rev.* **2015**, *34*, 278–297. [CrossRef]
95. Dhir, A.; Khalil, A.; Lonka, K.; Tsai, C.-C. Do educational affordances and gratifications drive intensive Facebook use among adolescents? *Comput. Hum. Behav.* **2017**, *68*, 40–50. [CrossRef]
96. Dhir, A.; Alsumait, A. Examining the Educational User Interface, Technology and Pedagogy for Arabic Speaking Children in Kuwait. In Proceedings of the 1st International Workshop on Interaction Design in Educational Environments, Wrocław, Poland, 28 June 2012; pp. 79–89. [CrossRef]
97. Evers, K.; Chen, S.; Rothmann, S.; Dhir, A.; Pallesen, S. Investigating the relation among disturbed sleep due to social media use, school burnout, and academic performance. *J. Adolesc.* **2020**, *84*, 156–164. [CrossRef] [PubMed]
98. Harrison, T. How distance education students perceive the impact of teaching videos on their learning. *Open Learn. J. Open Distance E-Learn.* **2019**, *35*, 260–276. [CrossRef]
99. Alam, G.M.; Asimiran, S. Online technology: Sustainable higher education or diploma disease for emerging society during emergency—Comparison between pre and during COVID-19. *Technol. Forecast. Soc. Chang.* **2021**, *172*, 121034. [CrossRef]

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