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Vocational Education, Skill Formation, and Social Development

Edited by
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Editorial

Vocational Education, Skill Formation, and Social Development

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Vocational education plays a crucial role in cultivating high-quality skilled professionals to meet the demands of social development and is intrinsically linked to industrial upgrading. Concurrently, the rapid advancement of the Fourth Industrial Revolution and the ongoing process of economic digitalization are reshaping the global financial structure, leading to profound transformations and a reconfiguration of the international landscape. In response to this evolving context, vocational education systems should continuously innovate their objectives, training practices, and assessments to better align with industrial demands. To enhance national comprehensive strength, secure a competitive advantage in talent development, and establish an international edge, countries worldwide are accelerating the formulation of skill-based personnel training strategies. This includes the introduction of various policies and initiatives to improve vocational education systems in these countries and position themselves favorably in international competition. The effectiveness of these policy implementations, their impact on skilled personnel, and their alignment with the direction of societal progress are critical areas of ongoing research.

1. The Increasing Importance of Vocational Education in Global Education Systems

In recent years, enhancing the alignment between vocational education and social development needs has become a strategic consensus shared by nations worldwide. China has placed significant emphasis on the role of vocational education in cultivating highly skilled professionals and master artisans, continuously strengthening its policy support. For example, in 2023, eight ministries, including the Ministry of Education of the People's Republic of China, jointly issued the "Implementation Program for Enhancing Action on Vocational Education Industry-Education Integration and Empowerment (2023–2025)" (National Development and Reform Commission of the People's Republic of China, 2023). This initiative focuses on five key areas: demonstrating the effort of deepening industry–education integration, optimizing the professional offerings of vocational colleges and universities, increasing state financial support, promoting industry–university-research collaboration and innovation, and implementing various incentives and support measures. Furthermore, the Chinese government has introduced programs such as the "1 + X" certificate system pilot (Ministry of Education of the People's Republic of China, 2019), which encourages students to acquire multiple vocational qualifications alongside academic certificates to better meet the evolving demands of the labor market.

Moreover, the United States is actively promoting vocational education through legislative changes and the introduction of new initiatives. In 2018, the enactment of the Strengthening Career and Technical Education for the 21st Century Act marked a comprehensive reform of the U.S. vocational education system, emphasizing the importance of school–business partnerships (Edgerton, 2022). Germany, a leading example of the dual

vocational education model, also launched the Vocational Education Excellence Program in 2022 (OECD, 2024). This program aims to enhance vocational education quality and international competitiveness by improving teachers' professional competence, expanding opportunities for student participation in international collaborations, and strengthening connections with industry.

In China, vocational education is often perceived as an independent segment of the education system. However, vocational education, when viewed in a broader sense, should not be confined to a specific type of education. Its core value lies in developing skills with deeper and more expansive connotations. Vocational education should be considered a multidimensional and cross-cutting educational process in this broader context. It encompasses the transmission of technical skills and the development of innovative capabilities, professionalism, and lifelong learning, all of which are essential for adapting to the needs of a rapidly changing society and economy. To improve the quality of vocational education development at a deeper level, we need to start from the following three perspectives. First, we focus on the employment quality and career development prospects of vocational education graduates, ensuring their better integration into society and helping them realize their value through enhanced employment guidance and services. Second, a more scientific and rational development plan for vocational education should be formulated and implemented to ensure the optimal allocation and effective use of educational resources. Third, we advocate promoting the internationalization of vocational education by strengthening international exchanges and cooperation, drawing on advanced global educational concepts and experiences, and advancing the international development of vocational education.

2. Vocational Education: A Key Driver of Skill Formation and Social Development

Vocational education is an important engine for skill formation and social change, as it aims to promote individual skill development and social development through training. On the one hand, vocational education plays a key role in skill formation and social progress by fostering personal skill development and contributing to societal advancement. On the other hand, vocational education is closely linked to social development, directly supplying the labor market with skilled workers and training professionals whose skills are highly aligned with market demands, significantly increasing social employment rates. In addition, technological progress is a major driving force for economic development, and skilled talent is essential for technological innovation and industrial upgrading, as well as for enhancing national technological innovation and improving international competitiveness.

3. Social Development: New Challenges and Opportunities for Vocational Education and Skill Formation

Vocational education is confronted with unprecedented challenges and opportunities in the context of technological innovation, industrial transformation, and the diversification of labor markets. While traditional vocational education systems have often focused on industry-specific technical operations, the rapid advancement of emerging technologies demands a shift toward cultivating cross-disciplinary competencies. The spread of digitalization and artificial intelligence calls for vocational education to train "tool users" and innovative talent who possess creativity, critical thinking skills, and a high degree of adaptability. In addition, vocational education continues to face deeply ingrained social biases. In some countries, it is still perceived as a "second-class" form of education, lacking the social status associated with academic education. This cognitive bias, which is particularly prevalent in specific cultural contexts, limits the widespread recognition

of vocational education. As a result, many families view it as supplementary education, which influences students' choices and discourages familial support. The social value and potential of vocational education are not fully acknowledged, causing some young people who aspire to pursue technical careers to lack the recognition and support they need from their families and society. This, in turn, exacerbates the challenges faced by vocational education and hinders its development as a respected and viable pathway for future careers.

Despite the numerous challenges facing vocational education, technological innovation and policy support have created new opportunities for its development. The integration of emerging technologies, such as online education platforms, virtual reality (VR), and augmented reality (AR), has led to the introduction of more flexible and efficient teaching models for vocational training. Moreover, government support has significantly increased the advancement of vocational education. Through measures such as increased financial investment, the optimized allocation of educational resources, and strengthened school–business collaboration, the government has provided vital support to the sector. Notably, in China, national policy explicitly aims to promote the deep integration of vocational education with industrial development, driving its transformation toward greener, more digital, and intelligent pathways to meet evolving societal needs (Fan, 2020).

To fully capitalize on these opportunities and address challenges, vocational education requires innovations in curriculum design, teaching models, resource allocation, and policy guidance to increase social value and recognition. This Special Issue explores the relationships among vocational education, skill formation, and social development, examining how to respond to current and future challenges. It also highlights the achievements of policies and various stakeholders in opening new avenues for the future development of vocational education.

4. Future Perspective

With the acceleration of social development and industrial transformation, vocational education and skill formation play increasingly critical roles in the modern labor market. Future vocational education must focus on cultivating skilled talent, enhancing students' comprehensive qualities, and advancing social equity and economic development.

First, attention should be directed toward the disruptive impact of technological innovations on the evolving needs of vocational education. The integration of artificial intelligence, big data, and other technologies into vocational education should be explored, particularly with respect to how these tools can optimize course design, teaching methods, and the overall student learning experience. By leveraging flexible education models, online learning platforms, and practical project-based courses, vocational education can more effectively foster skill development and improve students' employability.

Second, the holistic development of students' soft skills should be prioritized. In an increasingly globalized world, vocational education must also focus on enhancing students' cognitive abilities and critical thinking and cultivating versatile talent from an international perspective. Particularly in environments where globalization and localization intersect, vocational education struggles to balance global demands with local cultural characteristics. This issue must be addressed in future curricula and training programs.

Third, attention should be given to the relationship between the widespread expansion of general higher education and the evolving social perception of vocational education. While broadening access to degree programs has increased educational opportunities for many, it has also contributed to the stigmatization of vocational education in some societies. In certain regions, vocational education is still viewed as "low-end" education, lacking social recognition and value. Future research should explore how the growth

of general higher education influences public attitudes toward vocational education and investigate ways to promote the complementary development of vocational and general higher education by enhancing the social standing and recognition of vocational education.

Fourth, attention should be given to the social responsibility of vocational education in supporting disadvantaged groups. Vocational education plays a crucial role in improving the economic status of marginalized populations, particularly in economically underdeveloped regions. It provides employment opportunities for students and contributes to enhancing social equity and mobility. Future research should focus on how vocational education can more effectively fulfill its social responsibility, especially in assisting students from low-income families, ethnic minorities, and other marginalized groups in gaining access to development opportunities.

Fifth, the positioning and future development of vocational education warrant further exploration. Future research should investigate the role of vocational education within the broader education system, particularly its relationship with higher education. Additionally, the development of vocational bachelor's degree programs deserves closer attention. Research should strengthen theoretical discussions and provide practical guidance to support advancing vocational education, especially with respect to how to promote sustainable development through the integration of industry and education and through school–enterprise collaboration.

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Article

Does Vocational Education Matter in Rural China? A Comparison of the Effects of Upper-Secondary Vocational and Academic Education: Evidence from CLDS Survey

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Abstract: The Chinese government has emphasised the role of vocational education and training (VET) in promoting the rural economy. Since 2018, the government has invested heavily in setting up secondary vocational schools, training centres, specialised programmes, and courses in rural areas. This paper aimed to explore whether VET at the upper-secondary level leads to better labour market outcomes than academic education in Chinese rural areas. We also aimed to quantitively investigate the social prestige of vocational and academic education among rural residents by comparing the subjective social status level of those who graduated from upper-secondary vocational schools and general academic schools. We drew data from the China Labour-force Dynamic Survey (CLDS). A binary logit model and multinomial logit model were used in this research. The results showed that rural upper-secondary vocational graduates had an advantage over general graduates in terms of their income and employment stability. However, VET led to lower subjective social status when compared with general education. This study demonstrated that although promoting VET in rural areas could potentially benefit rural residents financially, cultural change is needed to ensure the elevation of the standing of vocational education and promote the worthiness, effectiveness, and capabilities that vocational graduates possess.

Keywords: vocational education and training; rural China; labour market outcome; employment stability

1. Introduction

Since the start of the reform era in 1978, the disparity between rural and urban incomes in China has increased markedly [1]. Rural residents have been recognised as a particularly disadvantaged group [2]. Although the achievements in the education of urbanised provinces in China have been widely studied and celebrated, the situation of rural youth remains under-researched [2,3].

Similarly to policymakers throughout the world [4], the Chinese government believes that vocational education and training (VET) is crucial to economic development [5]. VET provides enhanced access to education and an alternative pathway to increased earnings for individuals who are unable or unwilling to participate in academic education [6,7]. The *National Strategic Plan for Rural Revitalisation* reiterated that 'vocational education in rural areas is in need of vigorous development' [8]. Therefore, a number of strategies, such as improving rural residents' access to VET and setting up VET schools, have been initiated.

Numerous studies have revealed that upper-secondary VET can help generate economic returns and improve intergenerational mobility, especially in less-privileged areas [7,9,10]. However, qualitative studies on the Chinese VET sector have suggested that vocational education has lower social prestige than academic education [11,12], and rural parents are not willing to send their children to vocational schools [12]. Previous studies on VET in rural China have focused on its drop-out rates [2,13], quality [14], school performance [15], and the participation of rural women [16]. Few have addressed the effects

of upper-secondary VET on the labour market outcomes of rural residents, especially in comparison to academic pathways. This paper was intended to fill the gap in the literature by exploring whether VET leads to better labour market outcomes than academic education in Chinese rural areas and whether VET is economically worth pursuing for rural residents. We also aimed to quantitively investigate the social prestige of vocational and academic education among rural residents by comparing the level of subjective social status of those who graduated from upper-secondary vocational schools and general academic schools.

Following the introduction, we proceed with discussions on the upper-secondary education system in China, the Chinese VET sector, and its role in 'rural revitalisation'. The next section presents the theoretical foundation and hypotheses that underpin this study. Following the discussion of data, measures, and methodology, the major findings, discussion, and conclusion are presented.

1.1. The Chinese Upper-Secondary System

Since 1986, the Compulsory Education Law in China has required every student to complete nine years of education, including six years of primary education and three years of lower-secondary education [17]. At the end of the ninth grade, students have the option to take the High School Entrance Exam (HSEE or zhongkao), which places them into either an upper-secondary vocational school or a general/academic high school for another three years. After completing secondary education, students have the choice of continuing their education at a four-year university or a three-year vocational college [18]. While a number of studies have focused on the effect of higher (vocational) education on Chinese youth [19,20], this study aimed to fill the gap by exploring the upper-secondary sector, which includes the vocational route (e.g., specialised schools, skilled-worker schools, and vocational secondary schools) and the general/academic route (e.g., general high schools).

The upper-secondary sector in China has expanded steadily over the past three decades. The Chinese government considered the expansion of upper-secondary education as a necessary approach to meet the need for upskilling the workforce as well as to potentially increase residents' incomes, thus further eradicating social inequalities [21,22]. By 2019, 39 million students were enrolled in upper-secondary education, with 39.5% in the vocational route and 60.4% in the academic route [23].

1.2. The VET Sector and Social Status

The lower standing of the VET sector in China has been damaging the development of the skilled workforce [12]. In 2019, the Chinese government published the *Implementation Plan on National Vocational Education Reform*, which emphasised the equal standing of vocational education and general education [5]. The attractiveness of the VET sector is largely determined by whether it could bring equal economic return and social status when compared with general education. In terms of economic return, scholars of various countries have found that, compared with the graduates of general upper-secondary education, VET graduates could benefit from an increased level of economic returns [24,25]. However, in terms of social status, the advantage of VET in China is not particularly prominent. Vocational graduates are more likely to find themselves with a lower socio-economic status and receive limited upward social mobility [12]. Although vocational and academic secondary education are set at the same level, the vocational route is treated as 'an inferior option' [26]. Students are expected to experience their childhood and youth as dedicated and industrious labourers, producing the best possible test scores [12]. With the nationwide expansion of higher education as well as rapid urbanisation, Chinese parents, in rural and urban household alike, expect their children to proceed to the academic route and attend university, which may not have been possible when they were young [27]. Vocational students are considered as 'low-value' and 'low-quality' youth by the general public [11,12], and they tend to internalise this form of social stereotyping and accept their inferior status as vocational students [12].

When making an educational choice, one considers both the economic and non-economic returns of a certain type of education [28]. The decision to invest in education is closely related to the level of perceived upward social mobility that education could bring. Vocational education was highly regarded throughout the socialist era and was delivered by work units [29]. Vocational graduates were assigned to 'iron rice bowl' jobs, which guaranteed their livelihoods over the course of their lifetime [30]. Thus, the VET sector enjoyed great prestige and popularity, as young people would benefit by having the opportunity of upward social mobility [31]. However, since the start of the reform era, this training arrangement from the socialist era has become obsolete. Investing oneself in vocational education to become a worker or technician no longer brings lifetime job security and social respect in the market economy [31]. Based on the China Family Panel Survey, Wei and Bai found that the advantage of upper-secondary vocational education only existed among those who were born before 1980, and it gradually disappeared among those who were born after 1980 [32].

Despite the initiatives to reform the vocational education sector, the dilemma over the inferior status of vocational learning in Confucian tradition versus the need to develop 'a highly skilled workforce' remains [33]. The Confucian philosophy determined a hierarchy of work and the academic/vocational divide in Chinese society following the imperial era [34]. In the reform era, the perceived low status of vocational education and the subjective association between academic education and upward mobility were evident [35]. Confucian values advocate that 'the student should apply himself to be an officer'; thus, 'scholar-officials', who gained exam success through academic learning, enjoyed the highest positions in Imperial China, above the skilled workers and farmers [35] (p. 23). Similar to the social prestige given to the 'scholar-officials', by applying oneself to the academic route and achieving higher tests scores, one is considered a student of 'merit', representing high social value among young people [11,12]. One of the aims of this research was to quantitively explore the subjective social status of graduates of upper-secondary vocational education compared with those in the academic route.

1.3. 'Rural Revitalisation' through Developing VET

Although China may be one of the fastest-growing economies, the benefits of this economic growth 'have been bestowed mainly on urban residents' [1]. Since the start of the reform era, rural residents have been the least advantaged, kept separate from urban dwellers by a household registration system that denied them many welfare benefits and rights [1]. Aiming to eradicate the urban–rural disparity, the Chinese government has taken a number of measures to boost the rural economy [36]; for example, the *National Strategic Plan for Rural Revitalisation* was put forward in 2018.

Despite the recent success in the economy, the vocational education sector in China is not meeting the country's needs for upskilling [36–38], particularly in the context of the Fourth Industrial Revolution. In recent years, a series of reforms have been initiated by the Chinese government for the vocational education sector. At the end of 2017, *Plans on Deepening the Integration of Industry and Vocational Education* was published by the State Council [39]. In 2018, The *Guidelines on Promoting the Cooperation of Vocational School and Enterprise* was enacted, in order to provide students with improved industrial skills and knowledge [21]. As for the disadvantaged rural areas, developing a quality vocational education pathway for rural residents has been vital in the process of promoting rural revitalisation strategies [23]. Since 2018, the Chinese government has invested heavily in setting up secondary vocational schools, training centres, specialised programmes, and courses in rural areas. Approximately 55% of the total secondary enrolment was within the vocational pathway [39].

This paper aimed to investigate whether rural residents could benefit more financially from upper-secondary vocational schools than general academic high schools, as well as compare the subjective social status of those who graduated from these two pathways.

1.4. Theoretical Background and Hypotheses

One possible explanation for the connection between one's education and outcomes in the labour market is provided by the human capital theory. One's decision to invest in education is highly similar to a company's decision to invest in capital, which will increase productivity and generate higher earning. Becker distinguishes general human capital from specific human capital [28]. General human capital is not directly associated with a specific job, but it can be applied in various contexts and thus increase the expected returns in employment opportunities [40]. Specific human capital is directly applicable to a certain job and immediately increases productivity [41]. General human capital is normally obtained through general or formal education, while specific human capital is obtained through on-the-job training or vocational education. Therefore, the distinction between general and vocational education lies in their educational goals: vocational graduates would gain more practical and directly applicable skills and knowledge, while academic graduates would gain more analytical and abstract skills [42].

An individual's choice of investing in vocational education is based on the relevance of the skills acquired and the social position they may bring. According to E. O. Wright, the access to certain skills and certificates would set a distinctive place in class relations [43]. Those who obtain essential skills through vocational training may have the potential to achieve upward social mobility. Parkin also argued that the certification of skills through vocational training was associated with the level of social stratification in modern society [44].

Research on general/specific human capital at the secondary educational level demonstrates that in the domain of a small-scale business, vocational graduates require less practical training and have more expertise in work tasks than academic graduates [45]. Therefore, vocational graduates could apply their skills more rapidly than their academic counterparts while lowering the training costs for a potential employer. Vocational graduates may gain higher labour market returns due to their increased productivity than academic graduates, who may face lower returns but greater learning opportunities [46,47]. Vocational graduates, with their practical skills that are immediately applicable to the firm, may enjoy more employment stability than academic graduates, whose skills are highly transferable [48,49]. Therefore, we hypothesised:

H1: *Upper-secondary vocational graduates receive a higher level of income compared to graduates of general high schools in rural China.*

H2: *Upper-secondary vocational graduates are more likely to be in stable employment compared to graduates of general high schools in rural China.*

One of the aims of this paper was to investigate the social prestige of upper-secondary vocational and academic education among rural residents in China. Qualitative research on the Chinese VET sector has shown that the vocational route is often chosen by default or as a poor second choice by students and their parents [11,26]. The reform era witnessed the massive expansion of the Chinese higher education sector and the increased demand for university credentials, which is viewed as a mechanism for class closure. The proliferation of higher education credentials decreased the demand for VET, hence the lack of desire to become skilled workers [27].

Education credentials, especially academic ones, play a significant role in the distribution of job opportunities through the 'signalling effect' [19]. Based on evidence in urban China from 2003 to 2008, Hu found that academic graduates have been treated favourably in the labour market in terms of their starting salary and likelihood of finding a job when compared with vocational graduates [19,20]. This economic position of different types of graduates may reinforce Chinese young people's commitment to the academic pathway.

Moreover, under the influence of Confucian values, people have conferred social prestige and recognition on the 'scholar-officials' and academic graduates [34]. Developing VET may help to increase rural residents' incomes, therefore achieving 'rural revitalisation'. However, participation in VET does not necessarily lead to an increase in perceived social

status compared with those who graduated from general high schools. Therefore, we hypothesised:

H3: *Upper-secondary vocational graduates have a lower level of subjective social status compared to graduates of general high schools in rural China.*

2. Methodology

2.1. Data

In this research, we drew data from the China Labour-force Dynamic Survey (CLDS). Launched by the Centre for Social Survey at Sun Yat-sen University, the CLDS is a nationally representative, biennial survey of Chinese communities and individual workers. It adopts a multi-stage stratified sampling strategy to interview households from 29 provinces/autonomous regions (Tibet, Hainan, Macau, Taiwan, and Hong Kong SAR were not included). The CLDS provides information on respondents' demographic characteristics, type of education, income, and nature of work that has been used in various studies [50]. This study employed the 2018 wave of the CLDS and included 1302 respondents in rural areas. We only included those who completed their secondary education before 2018 and further restricted the sample to include only respondents with a valid input of gender, education, income, urbanicity, occupation, and socioeconomic status. Table 1 describes the variables used in this research.

Table 1. Variable description.

Variable	Type	Description
Education	Binary	='1' for VET; ='0' for general/academic education
Ln(income)	Numerical	Natural log of individual's annual income
Occupation	Categorical	An individual's occupation
Employment stability	Binary	='1' for stable work; ='0' for unstable work
Subjective social status	Categorical	An individual's perceived social status
Age	Numerical	Age as of 2018
Years of education	Numerical	Individual years of schooling
Gender	Binary	= '1' for male; ='0' for female
Experience	Numerical	The working life of the individual
Party membership	Binary	='1' for member of party; ='0' for not a member of party
Marriage	Binary	='1' for married; ='0' for unmarried
Employment type	Binary	='1' for formal employment; ='0' for informal employment
Father's years of education	Numerical	The father's years of schooling

2.2. Measures

The labour market outcomes and the perceived social prestige of graduates from upper-secondary education were captured in this study through the analysis of three dependent variables. The log-transformed value of the total annual income in 2017 served as the first dependent variable. We also measured the skill levels and collar type possessed by workers, following Hessels et al. [51]. Four major occupational groups were formed based on this taxonomy: highly skilled and white-collar, highly skilled and blue-collar, low-skilled and white-collar, low-skilled and blue-collar (see Table 2).

Table 2. Classification of four occupational groups.

Collar type	White collar	Legislators, senior officials, and managers; professionals, technicians, and associate professionals; clerks and service workers; shop and market sales workers.
	Blue collar	Skilled agricultural and fishery workers and craft and related trades workers; plant and machine operators, assemblers, and elementary occupations.

Table 2. *Cont.*

Skill level	Highly skilled	Legislators, senior officials, and managers; professionals, technicians, and associate professionals; skilled agricultural and fishery workers; craft and related trades workers.
	Low skilled	Clerks, service workers, and shop and market sales workers; plant and machine operators, assemblers, and elementary occupations.

The second dependent variable, employment stability, refers to the level of stability of a worker's job. By referring to studies on precarious employment [52,53], this study measured the level of employment stability using an indicator to separate those who had signed a formal employment contract from those who had not. Following previous research [54,55], subjective social status was measured by an individual's perception of his or her own position in the social hierarchy on a 10-step ladder. This study converted this continuous variable into a categorical one, with a score of 1–3 representing low-level social status; 4–7 average-level social status; and 8–10 high-level social status.

Along with the primary variables of interest, our study also included a number of control variables representing various demographic characteristics that could potentially obscure the connection between the type of education and employment outcomes. As shown in Table 1, these included age, years of education, gender, experience, party membership, marriage, employment type, and father's years of education.

2.3. Research Methodology

A Mincerian earnings equation was used to evaluate the graduates' economic returns from these two types of education [56]. The Mincerian income equation model is illustrated by Equation (1) below:

$$\text{Ln}(income) = \beta_0 + \beta_1 edu_i + \beta_2 A_i + \varepsilon, \tag{1}$$

where *income* is the individual's annual total income in 2017; edu_i is the core explanatory variable, representing graduates' type of education; A_i denotes a set of control variables; and ε is the residual.

A binary logit model was used to examine the effect of the two types of education on graduates' employment stability. Equation (2) below represents this model:

$$Stability_i = \ln\left(P_i / 1 - P_i\right) = \beta_0 + \beta_1 edu_i + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon, \tag{2}$$

where $Stability_i$ is the dependent variable, P_i represents the probability of achieving a stable job, β_0 is the constant term, edu_i stands for a graduate's type of education, and ε represents the residual.

A multinomial logit model was employed to analyse the relationship between the types of education and the degree of subjective social status. The maximum likelihood estimation (MLE) was utilised to calculate the coefficient in the multinomial logit model. The model is represented by Equation (3) below:

$$Status_i = \beta_0 + \beta_1 edu_i + \ldots + \beta_n X_n + \varepsilon, \tag{3}$$

where $Status_i$ is the dependent variable, edu_i stands for a graduate's type of education, β_0 is the constant term, X_n denotes a set of control variables, and ε is the residual. The base value of the independent variable in Equations (2) and (3) was set to 0.

3. Results

3.1. Descriptive Findings

The study's descriptive findings are presented in Tables 3 and 4. The average annual income of those with an upper-secondary education degree was RMB 45,211.44 (USD 6639.56), which was 1.24 times of the average annual income (RMB 36,416.29/USD 3547.94) of the rural residents in the sample. In 2017, the annual income of rural upper-secondary vocational graduates was slightly higher than that of their general/academic counterparts. In terms of employment stability, the proportion of rural vocational graduates with stable jobs was 17.5% greater than that of rural general graduates at the upper-secondary educational level. In terms of subjective social status, seven in ten rural graduates with upper-secondary education believed that their social status was at the average level.

Table 3. Descriptive statistics.

Variable	Mean (SD)/Percentage
Dependent Variable	
Income	45,211.44 (116,807)
Ln(income)	10.18 (1.08)
Occupation	
Low-skilled and blue-collar worker	23.8%
Highly skilled and blue-collar worker	13.4%
Low-skilled and white-collar worker	27.3%
Highly skilled and white-collar worker	9.3%
Employment stability	
Stable work	47.7%
Unstable work	52.3%
Subjective social status	
Low	25.6%
Average	70%
High	4.4%
Key Independent Variable	
Upper-secondary education (vocational)	0.27 (0.44)
Control Variable	
Age	42.60 (0.49)
Years of education	11.90 (0.39)
Gender (male)	0.61 (0.49)
Experience	14.07 (14.56)
Party membership (CPC)	0.11 (0.31)
Marriage (married)	0.81 (0.39)
Employment type (formal employment)	1.18 (0.52)
Father's years of education	3.66 (4.35)
Training (received)	0.12 (0.32)

Table 4. Comparison of upper-secondary general and vocational graduates.

	General	Vocational
N (%)	954 (73.3)	348 (26.7)
Income (RMB)	44,857.67	46,188.79
Employment stability (%)		
Stable work	41.8	59.3
Unstable work	58.2	40.7
Subjective social status (%)		
Low	27.0	21.7
Average	68.1	75.1
High	4.8	3.2
Total	100.00	100.00

3.2. Income

The ordinary least-squares (OLS) results regarding the relationship between the different types of upper-secondary education (general/vocational) and income are presented in Table 5. The first column shows the regression results of rural vocational education in comparison to general education in terms of income; columns 2–5 display the regression results of graduates from four occupational groups and their incomes. The regression results demonstrated that rural upper-secondary vocational graduates earned more than general graduates, which supported Hypothesis 1. The findings were still valid when socioeconomic, location, and family factors were taken into account. As can be seen in Table 5, in the blue-collar and highly skilled occupational group, the income of rural vocational graduates was significantly higher than that of their general counterparts by 32.1%.

Table 5. Results of the OLS model.

	Ln (Income)				
	Overall	**Blue-Collar Low-Skilled**	**Blue-Collar Highly Skilled**	**White-Collar Low-Skilled**	**White-Collar Highly Skilled**
Education	0.147(0.066) ***	−0.198(0.368)	0.321(0.082) ***	0.205(0.121)	0.180(0.194)
Years of education	−0.006(0.080)	0.026(0.247)	0.231(0.126) *	0.022(0.091)	−0.094(0.167)
Gender	0.342(0.072) ***	0.319(0.161) *	0.413(0.129) ***	0.335(0.104) ***	0.476(0.162) ***
Experience	−0.005(0.003)	−0.009(0.009)	0.002(0.005)	0.003(0.005)	−0.006(0.007)
Party membership	0.033(0.067)	0.175(0.106)	−0.024(0.302)	−0.001(0.106)	−0.194(0.163)
Marriage	0.272(0.137) *	0.754(0.359) **	0.189(0.173)	0.187(0.147)	0.407(0.233) *
Employment type	−0.526(0.067) ***	−0.407(0.362)	−0.534(0.130) ***	−0.172(0.110)	−0.392(0.131) ***
Father's years of education	0.025(0.008) ***	0.014(0.015)	0.036(0.012) ***	0.027(0.014) *	0.021(0.014)
Social status	0.017(0.021)	0.007(0.046)	0.010(0.030)	0.067(0.020) ***	0.003(0.057)
Training	0.392(0.075) ***	0.383(0.306)	0.111(0.243)	0.390(0.142) **	0.270(0.141) *
Constant	10.226(0.978) ***	9.226(2.907) ***	7.334(1.443) ***	9.414(1.169) ***	11.164(2.026) ***
N	925	287	166	348	121

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.3. Employment Stability

Table 6 shows the effect of the different types of upper-secondary education on the graduates' employment stability. The results indicated that rural vocational graduates had an advantage over general high school graduates in terms of employment stability, and that their chances of landing a stable job were 1.82 times higher than those of their general counterparts, which supported Hypothesis 2.

Table 6. Results of the binary logit model.

	Employment Stability			
			95% CI	
	Coef.	**Odds Ratio**	**Lower Bound**	**Upper Bound**
Education	0.599(0.295) **	1.82(0.537) ***	0.02	1.178
Years of education	−0.295(0.313)	0.745(0.233)	−0.909	0.319
Ln(income)	0.667(0.208) ***	1.949(0.404) ***	0.26	1.074
Age	−0.021(0.014)	0.979(0.014)	−0.049	0.006
Gender	−0.071(0.313)	0.931(0.291)	−0.684	0.541
Experience	−0.056(0.017) ***	0.946(0.016) ***	−0.089	−0.023
Party membership	−0.747(0.456)	0.474(0.216)	−1.64	0.147
Marriage	0.221(0.366)	1.247(0.457)	−0.498	0.939
Employment type	−3.534(0.529) ***	0.029(0.015) ***	−4.57	−2.498
Father's years of education	0.061(0.031) **	1.063(0.033) **	0.001	0.122
Social status	−0.11(0.081)	0.895(0.073)	−0.27	0.049
Training	−0.074(0.339)	0.928(0.315)	−0.739	0.591
Constant	3.557(4.414)	35.062(154.747)	−5.093	12.208
N		417		

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$.

3.4. Subjective Social Status

The relationship between the different types of upper-secondary education and the subjective social status level is presented in Tables 7 and 8. The results indicated that upper-secondary vocational education lowered graduates' chances of obtaining high-level subjective social status. In other words, upper-secondary vocational education graduates in rural areas were found to be less likely to perceive themselves as having high-level social status than general education graduates. Thus, Hypothesis 3 was supported.

Table 7. Results of the multinomial logistic model (low-level social status compared to average-level social status).

	Subjective Social Status			
			95% CI	
	Coef.	Odds Ratio	Lower Bound	Upper Bound
Education	−0.172 (0.187)	0.835(0.167)	−0.540	0.196
Years of education	−0.059(0.182)	0.942(0.172)	−0.415	0.298
Ln(income)	−0.251(0.081) ***	0.780(0.063) ***	−0.404	−0.097
Age	−0.00001(0.00001)	0.998(0.009)	−0.0003	8.94×10^{-6}
Gender	0.281(0.177)	1.328(0.241)	−0.066	0.628
Experience	−0.00001(0.007)	1.002(0.007)	−0.00003	0.00001
Party membership	−0.453(0.257) *	0.636(0.167) *	−0.960	0.053
Marriage	0.184(0.240)	1.230(0.323)	−0.287	0.655
Employment type	0.102 (0.150)	1.078(0.995)	−0.193	0.396
Father's years of education	−0.006(0.018)	0.995(0.018)	−0.042	0.029
Constant	1.842(2.302)	6.704(15.607)	−2.670	6.356
N			926	

Standard errors in parentheses. *** $p < 0.01$, * $p < 0.1$.

Table 8. Results of the multinomial logistic model (high-level social status compared to average-level social status).

	Subjective Social Status			
			95% CI	
	Coef.	Odds Ratio	Lower Bound	Upper Bound
Education	−0.966(0.506) **	0.357(0.185) **	−1.958	0.026
Years of education	−0.088(0.392)	0.925(0.364)	−0.856	0.680
Ln(income)	−0.083(0.166)	0.894(0.155)	−0.409	0.243
Age	−0.0002(0.00001)	0.984(0.021)	−0.0004	3.99×10^{-6}
Gender	−0.045(0.372)	0.898(0.335)	−0.774	0.684
Experience	0.037(0.124) ***	1.049(0.018) ***	0.013	0.062
Party membership	−1.012(0.628)	0.377(0.238)	−2.244	0.220
Marriage	0.058(0.572)	1.222(0.753)	−1.62	1.178
Employment type	−0.587(0.314) **	0.532(0.170) **	−1.203	0.029
Father's years of education	0.003(0.038)	1.013(0.038)	−0.006	0.078
Constant	−0.579(4.943)	1.090(5.482)	−10.269	9.110
N			926	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$.

3.5. Robustness Checks

The above logistic regression models partially disregarded the endogenous issue brought on by the interaction between the sample selection and variables, which may have led to biased estimate results. Therefore, we conducted an additional robustness check using trimmed samples (trimmed by 1%). Tables 9–12 presents the results from the trimmed samples. The estimates were largely consistent with the above estimates presented in Tables 5–8, demonstrating that the research results were robust.

Table 9. Results of the OLS model.

	Ln (Income)				
	Overall	**Blue-Collar Low-Skilled**	**Blue-Collar Highly Skilled**	**White-Collar Low-Skilled**	**White-Collar Highly Skilled**
Education	0.154(0.062) ***	−0.172(0.276)	0.320(0.155) ***	0.217(0.097) **	0.154(0.169)
Years of education	−0.011(0.074)	0.005(0.169)	0.244(0.191) *	0.001(0.108)	−0.034(0.183)
Gender	0.343(0.069) ***	0.312(0.13) *	0.333(0.185) ***	0.342(0.093) ***	0.607(0.179) ***
Experience	−0.005(0.003) *	−0.009(0.005)	0.002(0.006)	0.004(0.006)	−0.01(0.006)
Party membership	0.032(0.07)	0.172(0.201)	−0.004(0.263)	0.002(0.164)	−0.235(0.206)
Marriage	0.26(0.138) *	0.754(0.357) **	0.173(0.206)	0.164(0.111)	0.379(0.29) *
Employment type	−0.519(0.064) ***	−0.406(0.368)	−0.523(0.176) ***	−0.168(0.142)	−0.435(0.196) ***
Father's years of education	0.026(0.008) ***	0.014(0.017)	0.039(0.018) ***	0.031(0.011) ***	0.018(0.019)
Social status	0.017(0.021)	0.003(0.037)	0.013(0.040)	0.067(0.027) ***	−0.022(0.051)
Training	0.37(0.07) ***	0.383(0.261)	0.095(0.235)	0.385(0.131) **	0.197(0.155)
Constant	10.282(0.9) ***	9.489(2.131) ***	7.235(2.312) ***	9.646(1.292) ***	10.658(2.151) ***
N	922	286	165	348	120
R-squared	0.157	0.059	0.146	0.104	0.145
Number of province	27	25	22	25	24
Province FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 10. Results of the binary logit model.

	Employment Stability			
	Coef.	**Odds Ratio**	**95% CI**	
			Lower Bound	**Upper Bound**
Education	0.541(0.292) *	1.718(0.502) **	−0.032	1.114
Years of education	−0.266(0.313)	0.745(0.233)	−0.879	0.347
Ln(income)	0.663(0.207) ***	1.949(0.404) ***	0.258	1.067
Age	−0.022(0.014)	0.979(0.014)	−0.049	0.005
Gender	−0.035(0.311)	0.931(0.291)	−0.645	0.574
Experience	−0.056(0.017) ***	0.946(0.016) ***	−0.089	−0.022
Party membership	−0.718(0.455)	0.474(0.216)	−1.609	0.174
Marriage	0.25(0.363)	1.247(0.457)	−0.461	0.961
Employment type	−3.519(0.523) ***	0.029(0.015) ***	−4.544	−2.494
Father's years of education	0.06(0.033) **	1.063(0.033) **	−0.003	0.124
Social status	−0.11(0.081)	0.896(0.073)	−0.269	0.049
Training	−0.076(0.339)	0.926(0.314)	−0.741	0.588
Constant	3.557(4.414)	35.062(154.747)	−5.383	11.887
N		413		

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11. Results of the multinomial logistic model (low-level social status compared to average-level social status).

	Subjective Social Status			
	Coef.	**Odds Ratio**	**95% CI**	
			Lower Bound	**Upper Bound**
Education	−0.195 (0.198)	−0.195(0.199)	−0.584	0.195
Years of education	−0.051(0.183)	−0.051(0.183)	−0.409	0.308
Ln(income)	−0.254(0.082) ***	−0.254(0.082) ***	−0.415	−0.094
Age	−0.003(0.009)	−0.003(0.009)	−0.019	0.014
Gender	0.276(0.180)	0.276(0.18)	−0.078	0.629
Experience	−0.002(0.007)	0.002(0.007)	−0.013	0.016

Table 11. *Cont.*

| | Subjective Social Status | | | |
| | | | 95% CI | |
	Coef.	Odds Ratio	Lower Bound	Upper Bound
Party membership	−0.457(0.263) *	−0.457(0.263) *	−0.972	0.059
Marriage	0.213(0.262)	0.213(0.262)	−0.300	0.725
Employment type	0.098 (0.164)	0.098(0.164)	−0.224	0.420
Father's years of education	−0.004(0.019)	−0.004(0.019)	−0.041	0.033
Constant	1.870(2.331)	1.87(2.331)	−2.700	6.439
N			918	

Standard errors in parentheses. *** $p < 0.01$, * $p < 0.1$.

Table 12. Results of the multinomial logistic model (high-level social status compared to average-level social status).

| | Subjective Social Status | | | |
| | | | 95% CI | |
	Coef.	Odds Ratio	Lower Bound	Upper Bound
Education	−1.088(0.515) **	−1.088(0.515) **	−2.097	−0.080
Years of education	−0.060(0.394)	−0.06(0.394)	−0.832	0.711
Ln(income)	−0.123(0.176)	−0.123(0.176)	−0.467	0.221
Age	−0.022(0.021)	−0.022(0.021)	−0.063	0.019
Gender	−0.026(0.373)	−0.026(0.373)	−0.758	0.706
Experience	0.049(0.017) ***	0.049(0.017) ***	0.016	0.082
Party membership	−0.986(0.631)	−0.986(0.631)	−2.223	0.251
Marriage	0.295(0.612)	0.295(0.612)	−0.905	1.496
Employment type	−0.611(0.315) **	−0.611(0.315) *	−1.223	0.006
Father's years of education	0.010(0.039)	0.01(0.039)	−0.066	0.087
Constant	0.120(5.055)	0.12(5.055)	−9.787	10.027
N			918	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4. Discussion

Based on CLDS data, we compared the labour market results of two types of upper-secondary education (the vocational and general pathways) in rural China in terms of the graduates' income and employment stability. We also compared their subjective social status. This produced a number of noteworthy findings.

Firstly, the different types of upper-secondary education led to discrepancies in graduates' incomes in rural China, with graduates of the vocational route benefiting from an economic advantage. This was similar to the results generated by a study in Switzerland, indicating higher wages for vocational graduates compared with academic ones [42]. However, this contradicted the empirical results concerning graduates at the post-secondary level in urban China, which showed that post-secondary academic graduates enjoyed more advanced labour market positions than their vocational counterparts [57,58]. It was evident that in rural China, compared with the general/academic pathway, the upper-secondary vocational pathway improved students' future incomes, especially as blue-collar highly skilled workers. Secondly, the results of this research also demonstrated that, in comparison to the jobs of academic graduates, the jobs held by upper-secondary vocational graduates involved a higher level of security. The specific human capital acquired by vocational graduates could enable them to immediately apply their practical skills to the workplace and benefit from a higher level of employment stability [41]. Finally, this research showed that even though graduating from upper-secondary vocational education could increase one's income and employment stability, it still led to a lower subjective social status compared with experiencing a general education. This concurred with the findings of qualitative studies showing that vocational education is considered inferior or a

poor second choice [11,12]. It was apparent that these societal sentiments about the low standing of vocational education and its associated occupations were still pervasive. Those graduating from the vocational route perceived themselves to be at a lower level of the social hierarchy compared with those in the general route.

Apart from the education factor, it is evident that gender relations also have a significantly impact on the income disparity in rural China. Since the beginning of the reform era, marketisation has increased gender income inequality in China's labour market [59]. Based on China Household Income Project (CHIP) data, Kim argued that female workers were in a disadvantage position in terms of human capital accumulation when compared with male workers [60]. The gender gap in earnings and employment remains alarmingly apparent and requires that policymakers take gender factors into account.

This paper showed that upper-secondary vocational education is a pathway with significant potential and value in rural China, yet those who benefited from it did not perceive their social position as favourable. The perceived undesirable social status among vocational graduates could potentially lead to the even lower attractiveness of vocational education [61]. The Chinese government is urged to highlight the goal of promoting the parity of esteem between the vocational and academic routes, positioning vocational learning as a beneficial alternative that is crucial to all students. Rather than being marginalised as an 'inferior option' [26], vocational education should be collaboratively promoted by multiple actors, including policymakers, industry advisors, employers, educators, and community workers.

5. Conclusions

The aim of this research was to explore whether VET at the upper-secondary level leads to better labour market outcomes than academic education in Chinese rural areas. Drawing data from the China Labour-force Dynamic Survey (CLDS), we also quantitively investigated the social prestige of vocational and academic education among rural residents by comparing the level of subjective social status of those who graduated from upper-secondary vocational schools and general academic schools. Admittedly, for this paper, we used a rather small sample of rural graduates with upper-secondary education from the CLDS 2018, which introduced a number of limitations. It prevented our study from investigating other factors influencing rural graduates' labour market results. It is possible that unobserved variables existed that may have led to biases in our casual inferences. Nonetheless, this paper represents a contribution to the literature on the labour market outcomes of upper-secondary graduates in rural China, as well as their subjective social status. In recent years, the Chinese government has put increased emphasis on vocational education, which could produce the 'skill-oriented talents' that the Chinese economy desperately requires [36]. In particular, this study demonstrated that the *National Strategic Plan for Rural Revitalisation,* which promotes vocational education in rural areas, could potentially benefit rural residents financially and possibly bring more job security for rural youth. However, cultural change is needed to ensure the elevation of the standing of vocational education and promote the worthiness, effectiveness, and capabilities that vocational graduates possess.

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Article

Developing Critical Thinking in Technical and Vocational Education and Training

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Abstract: Critical thinking has been difficult to develop in technical and vocational education and training, where acquiring practical skills is often the priority. This study looks at whether tried-and-tested methods for developing critical thinking in higher education are also effective in this educational context. To test this, an intervention was carried out as part of a compulsory, semester-long "Basic Communication Skills" class for 149 first year engineering students. This involved linking the expected learning outcomes for the course to a series of sub-skills comprising an updated definition of critical thinking. Furthermore, a set of strategies promoting active participation among students was also implemented. The proposed methodology led to improved levels of critical thinking when compared to traditional teaching methods. It was found that lessons characterized as interactive, dynamic, and encouraging active student participation facilitate the teacher's job in the classroom and improve the development of critical thinking in a specific technical and vocational education context.

Keywords: critical thinking; technical and vocational education and training; instructional design; student engagement

1. Introduction

Technical and vocational education and training (TVET) refers to the education, training, and skills development required for specific occupational fields [1]. The automation of many manufacturing and production processes has put TVET in the spotlight [2]. In response to this issue, a recent UNESCO report has acknowledged the need to develop digital, environmental, entrepreneurial, and soft skills among workers to prepare them for the future of work [3]. In this sense, 21st Century Skills are seen as one possible solution for TVET [4].

21st Century Skills can be defined as a wide-ranging set of abilities, including creativity, communication, collaboration, and critical thinking, among others [5]. Critical thinking is acknowledged as being an important goal for many professionals within higher education [6]. This is because it is an important tool for facing different challenges that may arise in the workplace. This includes the ability to identify which knowledge may be suitable for a certain problem and how to apply it as part of the solution [7]. However, critical thinking has been difficult to develop in technical and vocational education and training, where acquiring practical skills is often the priority [8]. This is mainly because of a focus on developing competences and skills that directly help solve the problems that workers will face when they join the workforce. This, in turn, has created a skills gap

which must be addressed [9]. Developing critical thinking in TVET is one way of reducing such gaps.

Critical thinking development in TVET is novel. Among other 21st century skills, critical thinking has been recognized as being one of the most desirable attributes within industry (Din Nugraha et al., 2020). There is some evidence regarding activities that can develop higher-order thinking skills in general [10], as well as general guidelines on how to teach critical thinking and integrate it into pedagogical practices in TVET [11,12]. However, there is still a need to design interventions that can develop this skill [9].

To do so, critical thinking must first be defined. There are many approaches to defining this skill in the literature. One such approach claims that critical thinking can be seen as the process of analyzing and evaluating the thinking process in order to improve it [13]. Others claim it is a skill related to solving problems in different contexts [14]. Through the Delphi Report, Facione defined critical thinking as a set of sub-skills, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation [15]. This is the definition that has been adopted for our study. This is because in critical thinking, as in any problem-solving situation, you first need to have a deep understanding of a problem before thinking about the solution. Failing to do so would lead to a surface-level solution that does not require critical thinking [16]. Facione's definition therefore proposes a taxonomy of sub-skills, requiring a person to first understand a problem (interpretation and analysis) before assessing solutions (evaluation). They must then search for non-explicit causes or consequences (inference) and communicate this process as a whole (explanation) before reflecting on the process and results (self-regulation). Such a process leaves no room for a superficial solution, which is precisely the problem facing today's TVET workforce [9]. In this sense, the other approaches to critical thinking do not seem as appropriate as they may lead to superficial thinking. In doing so, subjects may never develop the sort of deeper thinking and reasoning that would allow them to become more integral workers [17].

Facione's approach to defining critical thinking not only provides benefits for TVET students in their work-related activities; it also benefits other aspects of their life. It can help improve their comprehension of media information and critical reasoning [18]. It can also help facilitate authentic dialogues and mediation between different worldviews [19]. Consequently, critical thinking can help people better understand and evaluate data so as to make better real-life decisions [17]. In consequence, critical thinking can also be key in developing citizens for the 21st century [20].

The above definition provides us with a clear understanding of critical thinking and how this approach can lead to deeper thinking. This definition will be operationalized in Section 2.1. Now, it must be understood how critical thinking can be developed. Therefore, there needs to be an analysis on how to develop critical thinking in a TVET context and understand which activities may foster the development of this skill. Dialogue, exposing students to real-life situations, and mentoring have all proven to be effective strategies for developing critical thinking [6]. Setting out a problem, activating prior knowledge, demonstrating, applying, and integrating have also been shown to promote this skill [21]. Furthermore, active learning methodologies, teacher training, and student support have all been shown to be essential for developing critical thinking [22–24]. However, all of these activities have been proven in a general higher education context, but not in TVET.

Some more recent activities for developing critical thinking include promoting critical dialogue between students, facilitating metacognitive processes, using guided and practical models, and giving ongoing formative feedback, among others [25]. Some other effective activities include providing oral and written reflections; argumentation; reading, analyzing, and summarizing texts; and case studies [26].

These references, as well as a review of the literature, suggest how to develop critical thinking at every level of education, except for TVET [23]. This is particularly relevant given that the nature of TVET is different to traditional higher education, as was shown before [27]. TVET tends to attract students from lower-income families and with lower levels of motivation [28]. Furthermore, TVET is often seen as a fallback option [29] and can result

in low employability [30]. This therefore raises the question of whether the experiences, activities, and methodologies that have been proven to develop critical thinking in higher education are also applicable to TVET. Consequently, our research question asks: "How can critical thinking be developed within technical and vocational education and training?".

2. Materials and Methods

2.1. Operationalization of Definition of Critical Thinking

The chosen definition of critical thinking proposes it as a taxonomy of the following sub-skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation.

Interpretation is the ability to extract information from a wide range of situations. Analysis is the ability to identify implicit and explicit relationships between written and audiovisual resources. Evaluation is the ability to evaluate judgements and develop rubrics in order to do so. Inference is the ability to draw conclusions. Explanation is the ability to justify one's reasoning. Finally, self-regulation is the ability to consciously self-monitor one's cognitive processes.

These sub-skills fail to consider a person's argumentation skills [26], i.e., the ability to establish a position and provide arguments [31]. Evidence, in the form of an argument, can be used to support an explanation [31]. Therefore, explanation was replaced with argumentation in our definition of critical thinking.

Furthermore, metacognition is defined as the ability to conceptualize the cognitive process of oneself or of others [32]. This includes the planning, monitoring, and evaluation of said process [25]. Furthermore, self-regulation is considered an act of cognitive self-monitoring [33]. Therefore, self-monitoring was replaced with metacognition in our definition of critical thinking.

Consequently, the definition of critical thinking used in this study comprises the sub-skills interpretation, analysis, evaluation, inference, argumentation, and metacognition. It is worth noting that this definition has been used consistently for critical thinking development experiences [16,23,25,34]. This therefore suggests that the definition is also suitable for a development context. Now, the difference between sub-skills and dispositions will be analyzed. The Delphi Report from Facione not only proposes critical thinking as a composition of sub-skills but also a set of dispositions [15]. Truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and cognitive maturity are mentioned as cognitive and motivational dispositions that may promote the development of critical thinking [35]. Critical thinking sub-skills and dispositions are needed to become a critical thinker, with the link suggesting which attitudes are required for a person to develop critical thinking [16]. In this sense, these dispositions were addressed in our study by including active engagement as a basis for the critical thinking development methodology. Guidelines were included for areas such as peer discussion, higher-order thinking, and working with real-world topics, among others.

2.2. Experimental Design

The study was conducted at Chile's second largest technical and vocational education and training college. The intervention was carried out as part of a compulsory, semester-long "Basic Communication Skills" class for first year students enrolled at the college. This course aims to develop the students' writing and speaking skills, as well as their reading comprehension, taking a pragmatic and functional approach to the study of language. The study took place over the course of one semester (18 weeks) and involved ten different groups of students from the Electrical and Industrial Automation degree (149 students in total). The students were randomly assigned to experimental or control groups (see Table 1). All groups followed the same course plan and were taught by the same teacher. However, the teacher used different methodologies for the experimental and control groups.

Table 1. Sample Characteristics.

Group	Number of Students
Control	70
Experimental	79

The course "Basic Communication Skills" was chosen mainly because communication is considered a 21st Century Skill. Furthermore, TVET is characterized by the teaching of content and techniques that are specific to a particular domain [1]. Therefore, students in TVET must be trained in the adequate use of language [36]. More importantly, and on a more general level, communication is key to transmitting information. This is done by ensuring that the message is effectively expressed by taking the audience into consideration. Consequently, this allows people to regulate their own needs and goals and align them with those of society [37]. Communication is, therefore, how TVET students will interact with the rest of the world. Furthermore, if critical thinking is to be a tool to help people understand the world better, then language is key [38].

2.3. Creating a Methodology for Developing Critical Thinking

Following an immersive approach, students can acquire critical thinking skills while developing subject content knowledge. In this case, there is no need for explicit instruction of critical thinking [39]. As part of this approach, learning is fostered when students work on solving real-world problems, when prior knowledge is activated as the basis for acquiring new knowledge, when new knowledge is demonstrated to students, when students can apply new knowledge, and when new knowledge is integrated into the students' own world [40]. Therefore, the challenge was to determine how to build a methodology for developing critical thinking while also achieving the expected learning outcomes of the "Basic Communication Skills" course. To do so, the learning outcomes for the course were associated with the critical thinking sub-skills. Table 2 shows the links between the expected learning outcomes for the course and the six sub-skills comprising the definition of critical thinking.

Table 2. Relationships between learning objectives and the sub-skills of critical thinking.

Sub-Skill of Critical Thinking	Expected Learning Outcome
Interpretation	Objectives associated with the extraction of literal information from written and spoken texts.
Analysis	Objectives associated with summarizing ideas and organizing information from written and spoken texts hierarchically.
Inference	Objectives associated with extracting non-literal information from written and spoken discourse.
Evaluation	Objectives associated with grammar (accent marks, punctuation, and connectors, among others) and the structure of a text.
Argumentation	Objectives associated with identifying an author or speaker's point of view and their reasoning.
Metacognition	Objectives associated with self-regulation and monitoring during the process of speaking, writing, and listening/reading comprehension.

Several studies have suggested that student engagement is a key factor in the learning process, associated with a higher probability of academic success and lower levels of student attrition [41]. It has been shown to positively affect critical thinking, self-efficacy, and communication skills [42] as it requires autonomy and active participation from the students [43].

Motivation is understood as "the mental state in which students find themselves while learning, representing the intersection between thoughts and feelings" [44]. Furthermore, student engagement is directly correlated with student motivation and active learning [44]. The concept of student engagement will therefore be taken as a student's active participation in their own learning process. Furthermore, the use of technology was also included, as it can have a direct impact on student motivation [45]. This was accomplished using Plickers, which will be explained later.

Strategies to demonstrate critical judgement, examine statements, and determine the robustness of an argument [46] were looked at to foster active student engagement, the development of critical thinking, and the learning of subject content knowledge. Therefore, the following guidelines for student-centered learning were set out:

- Use of multimedia in class: Allow students to work with different types of discourse, whether text, videos, images, audio, animations, or others. These are tools that help students develop concepts, analytical reasoning, creative thinking, problem solving and critical thinking [47]. Such resources should be brief and concrete so that the students do not become distracted.
- Working with controversial or real-world topics: To boost student interest and engagement, there must be strong social relationships between the teacher and students, as well as suitable rules for interaction and the facilitation of debate [48]. This relationship can be strengthened in class by addressing topics that are controversial or from real-life situations, as there is evidence suggesting that a real-world connection can be an effective methodology for developing critical thinking [26]. Controversial topics were proposed because exposing students to opportunities for dialogue is also an effective way of developing critical thinking [34]. Even though it can polarize students, it is also an opportunity for them to consider alternative perspectives [49], which may also be directly related to the evaluation sub-skill in or definition of critical thinking.
- Introducing peer discussion routines: Peer discussion promotes the development of critical thinking [50].
- Reflective questions and higher-order thinking: There is a need for reflective questions, which go beyond basic recall and instead promote metacognition on current topics [51].
- Using low-cost technology: Simple, open-access technology was used to promote student participation. The class poll system Plickers was used [52], where students answer using a preprinted QR code that is scanned by the teacher's cellphone.

Based on these general guidelines, a methodology was proposed with the following objectives in mind:

(1) To be a dynamic class, in which the student frequently gets to "do" things.
(2) To have clearly defined and distinct phases: presentation of content, practice, and a conclusion involving a metacognitive activity to reflect on the learning process.
(3) To regularly ask questions about one of the sub-skills of critical thinking using Plickers.

These guidelines and objectives provided the following general structure for the 20 classes:

1. Icebreaker or "Do it now!": A short activity to introduce the main topic of the class in no more than 5 min. Icebreakers are an effective way of boosting student engagement [53] as they improve enthusiasm and help get the attention of the class [54].
2. Sharing the lesson objective: A short activity of no more than 2 min to explain the expected learning outcomes for the lesson.
3. Presentation of content: In no more than 5 min, the content is presented to the class.
4. Practice: Practical exercises to consolidate the newly-acquired knowledge and relate it to one of the sub-skills of critical thinking based on different texts, images, or videos, in groups or individually. After each practice, a Plickers activity is performed based on the content and the aforementioned sub-skill.
5. Focus on grammar: A short section of no longer than 8 min focusing on grammar. The main aim is to measure the sub-skill of evaluation and provide space for teaching grammar, a core element of the course.
6. Turn and discuss: A section for talking about a controversial point from the class. The students are asked an open-ended question and must then reflect on it both individually and with a peer.
7. Metacognitive routine: A concluding section in which the students go through a metacognitive routine based on an activity or item of content from the class.

While the experimental groups were taught following the methodology described above, the control groups were taught from the coursebook provided by the institution and without any additional materials. The approach for the control group was based heavily on reading texts and drilling reading comprehension, listening comprehension, writing, and speaking. The classes were complemented by the use of videos and infographics, with a particular focus on levelling out the students' reading comprehension skills.

An example of a class following the proposed methodology can be found in Supplementary Material S1.

2.4. Instruments for Measuring Critical Thinking and Learning

A wide range of critical thinking tests is described in the literature. A list of 18 instruments that can be used to assess critical thinking can be found in Appendix A. All of these instruments have different types of questions, are of different lengths, and are based on different constructs. The instruments include information about the context in which they were validated and general characteristics of the subjects that answered them. This is particularly relevant, as each time an instrument is validated with a different sample population, it should be revalidated [55]. Moreover, everything within the context in which an instrument is validated can be defined as being culturally relevant in an instrument for assessing critical thinking [56]. However, culture is often ignored as being a relevant factor in such tests. This is because, as a skill, it cannot really be measured independently of its cultural context [57]. Therefore, when existing critical thinking assessments were analyzed for suitability for our subjects, it was decided that the cultural elements of each test would interfere in its comprehension and probably in the results. This is why we decided to create our own instruments instead.

Consequently, pre- and post-tests were developed to measure critical thinking. These were based on the theorical definition of critical thinking presented in Section 1 and its operationalization (Section 2.1). The difference in the scores on both tests was used to assess improvements in the students' critical thinking skills. Although equivalent, the two tests were not identical. This was to avoid students learning from the test and/or remembered elements that may then affect the results [58].

Both tests used the definition of critical thinking established above as a theoretical construct. In this sense, each question on the two tests focused on one of the sub-skills included in the definition of critical thinking: interpretation, analysis, inference, evaluation, argumentation, and metacognition.

Furthermore, the tests included both multiple-choice and open-ended questions. The questions related to higher-order thinking skills (from a taxonomical point of view), i.e., argumentation and metacognition, were open-ended. This is because open-ended questions are better at measuring these kinds of skills than multiple-choice [59]. The responses to these questions were corrected by an expert and given a dichotomous score. The questions related to lower-order thinking (i.e., interpretation, analysis, inference, and evaluation) were expressed as multiple-choice [60] and also given dichotomous scores. Some questions, especially those for higher-order thinking skills, were separated into multiple items. The aim of doing so was to convey their complexity while keeping item scores between 0 and 1. Appendix B includes a detailed breakdown of the items on the test, including the sub-skill they relate to as well as the item type. As an example, question 15, which was related to the sub-skill of argumentation, consisted of asking subjects to write a short essay on a specific topic, including two arguments and one counterargument. This question was separated into five items, which were scored dichotomously (0 or 1). The first item checked whether subjects referred to the topic stated in the question. The second item checked whether they included a thesis statement. The third item checked whether they included an argument that supported this thesis. The fourth item checked whether they included another argument that supported their thesis (different from the last one). The final item checked whether they included a counterargument correctly. All questions (regardless of their type) were therefore given a score of 0 or 1.

The questions were based on a range of resources (such as advertisements, news articles, micro stories, opinion columns, and infographics, among others). These resources were based on real-life situations and problems, which provided a suitable context for evaluating the students' level of critical thinking [61]. For example, for the sub-skill of metacognition, all of the questions on the pre- and post-tests were based on a 30-s advertisement. Specifically, the questions addressed culturally relevant issues for the corresponding students. In Supplementary Material S2, we find, for example, question IC16 (from the pre-test) and question IC17 (from the post-test), which cope with a story that connects directly to the students' reality.

Details of each test, item, critical thinking sub-skill related to each item, question type, and type of resource used can also be found in Appendix B. To compare the scores on the pre- and post-tests, the total score for each test are expressed as a percentage.

The pre- and post-tests were validated on a total sample of 774 students. The pre-test was taken by a total of 502 students, while the post-test was taken by 274 students. These 774 students differ from the 149 specified in Section 2.2 because the validation of the critical thinking assessment required a larger sample [62]. These 774 students are all part of the same TVET institution where the study took place and have similar characteristics as the subjects from the sample specified in Section 2.1.

Additionally, and throughout the course, students had to complete several assessments, including essay questions, multiple-choice quizzes, and roleplays, among others. The aim of these assessments was to measure learning of the initial learning outcomes from the course. The final grade for the course, called "course score", was the only one of these assessments that was taken into consideration for this study. It used a scale from 1 to 7, commonly used in the Chilean education system. It was included to assess a possible relationship between critical thinking and academic achievement, a common relationship in other educational contexts [63]. This is relevant for the research question as the existence of this relationship may be a direct consequence of the development of critical thinking and, more importantly, assesses whether the methodology also allows the achievement of the learning outcomes. If not, and considering the context in which it was created (TVET education), it may fail as a methodology if it does not allow the obtention of the learning outcomes, regardless of whether critical thinking is developed or not.

2.5. Teacher Surveys

As a course requirement and as requested by the college, all of the students had to fill out an end-of-course survey. This survey featured 16 questions and a space for students to leave their comments. The first 15 questions were based on a four-point Likert scale, ranging from "Strongly disagree" to "Strongly agree". Question 16 required students to grade their teacher on a scale of 1 to 7. Finally, after these 16 questions, the students were provided with a space to leave their comments. The full survey can be found in Supplementary Material S3. This survey was applied as part of a teacher improvement process that is conducted every six months across all courses. While it is a requirement for every course, not all students were required to respond. In this case, the survey was built by the department in charge of all Basic Communication courses within the college. The results from the survey were included in order to have a quantitative and qualitative appraisal of the proposed methodology for developing critical thinking. Quantitatively, to analyze whether there are significant differences in any of the first 16 questions between the experimental and control group. Qualitatively, and by an appraisal analysis, to assess which elements of the methodology are more important for developing critical thinking.

2.6. Data Analysis

2.6.1. Quantitative Analysis

The reliability of the tests was analyzed using Cronbach's alpha. Item difficulty was measured using the *p*-value for each question. Item discrimination was measured using

item-total correlation, specifically an uncorrected point-biserial, following a Classical Test Theory Approach [64].

The internal structure of the pre- and post-tests was analyzed to demonstrate that they are equivalent. Both tests have the same construct (i.e., they are built around the same definition of critical thinking). Therefore, if they both show a unidimensional model (critical thinking), they can be considered equivalent [65]. Information-based model fit statistics [66] were used to show that a unidimensional model explains the internal structure. This model was based on Item Response Theory, where the dimension in question is critical thinking. The tests can therefore be considered equivalent. This was achieved by first analyzing whether the data can be used to identify factors using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy [67], as well as Bartlett's test of sphericity to analyze the factorability of the correlation matrix [68]. The internal structure is then validated using the root mean square error of approximation (RMSEA) [62].

This analysis was performed using the results from the 774 students who participated in the validation of pre- and post-tests.

Bayesian linear regression modeling [69] was proposed for identifying the association between the response variable (post-test) and the available independent variables (pre-test, group, and course score). This analysis was performed using the results from the 149 subjects enrolled in the "Basic Communication Course". As the sample size is relatively small (149 subjects in total, with 70 belonging to the control group and 79 to the experimental group), the Bayesian approach works more robustly than the frequentist approach [70]. Another advantage of the Bayesian framework is that uncertainty is measured probabilistically without resorting to a test statistic (or *p*-value) or asymptotic approximations that depend on the sample size [71]. Mathematically, the proposed model is written as follows (see Equation (1)):

$$Y_i = X_i^\top \beta_i + \epsilon_i, \tag{1}$$

where Y_i represents the post-test score of the ith student and X_i is their covariate vector with coefficients $\boldsymbol{\beta}$. The error term is denoted by ϵ_i and follows a Normal $(0, \sigma^2)$ distribution. The prior distributions are non-informatively assigned [69] according to the default specification of the brms R-package [72]. The coefficients for the independent variables used in this regression can be found in Table 3.

Table 3. Bayesian linear regression coefficients.

Coefficient	Reference	Description
β_0	Intercept	Attributable to the regression model
β_1	Pre-Test	Decimal number between 0 and 100, representing the student's score on the pre-test
β_2	Group	Student's group. 0 for control and 1 for experimental
β_3	Course score	Student's final grade for the course, expressed as a decimal number between 0 and 100

All analyses were performed in R [73].

The data from the teacher survey were analyzed as aggregated data. Welch's *t*-test [74] was used to analyze any potentially significant differences in the mean scores between the control group and experimental group. The effect size of any significant differences was also calculated. Any significant differences between the groups can shed light on which elements from the methodology may have been more successful in developing critical thinking.

2.6.2. Qualitative Analysis

The results from the survey were included in order to have a qualitative appraisal of the proposed methodology for developing critical thinking. More specifically, there was an interest in assessing which elements of the methodology are more important for developing critical thinking.

In order to assess which elements of the methodology are more important for developing critical thinking, only 32 comments (17 experimental and 15 control group) were

received on the teacher survey, considering that the completion of it was voluntary. This data was studied using Discourse Analysis, specifically Appraisal Analysis, which falls under the umbrella of Systemic Functional Linguistics (SFL). This theory allows construction and interpretation of meaning within its social context [75], thus allowing the discovery of relevant elements from the data. Three aspects were considered, Attitude, Engagement, and Graduation, as explained in Appendix C.

3. Results

3.1. Instrument Validation

Item difficulty and discrimination were used to validate the pre- and post-tests. These values and the items that were eliminated from each test can be found in Appendix D. Any questions with a difficulty index outside the range of 0.1–0.9 were removed [62]; three from the pre-test (leaving 29 questions) and two from the post-test (leaving 32 questions). Then, the internal structure of the instruments was analyzed to determine their equivalence. Since the RMSEA threshold of 0.08 was met with a 90% confidence interval (Table 4), we can state that a unidimensional model based on our proposed definition of critical thinking explains the structure and that, consequently, both instruments are equivalent [55,76].

Table 4. Analysis of the Internal Structure of the Instruments.

Instrument	KMO	Barttlet's Test of Sphericity	Log-Likelihood	M2	*p*-Value	df	RMSEA 5% *	RMSEA	RMSEA 95% **
Pre-Test	0.65	$p < 0.001$	−8.507	810	<0.01	348	0.047	0.051	0.056
Post-Test	0.67	$p < 0.001$	−5.038	888	<0.01	432	0.056	0.062	0.068

* Lower limit for the RMSEA with a 90% confidence interval ** Upper limit for the RMSEA with a 90% confidence interval.

Finally, Cronbach's alpha can be used to analyze the reliability of both instruments in order to validate them. Cronbach's alpha for the pre-test is greater than 0.6 (Table 5). Having conducted an IRT analysis, this validation can be complemented using marginal reliability based on an Expected a Posteriori (EAP) estimate [77], which is greater than 0.7 (Table 5). Both of these values are acceptable for a low-stakes learning outcome [62]. In the case of the post-test, Cronbach's alpha is greater than 0.7, which is the threshold usually found in the literature [76,78], with a marginal reliability also greater than 0.7, thus demonstrating the validity of both instruments.

Table 5. Reliability of the instruments.

Test	Cronbach's Alpha	Marginal Reliability
Pre-Test	0.67	0.76
Post-Test	0.72	0.87

3.2. Differences between Pre- and Post-Tests

The results from the pre- and post-tests, as well as the course score for each group (control and experimental), can be found in Table 6. To compare the scores on the pre- and post-tests, the total scores on each test are expressed as a percentage. This was calculated by adding up the scores from each item and dividing by the total.

The information available for each student (i.e., pre-test, group, and course score) was analyzed using the Bayesian linear regression model [69]. The running configuration to achieve convergence was set at 3 chains with 20,000 iterations, where the first 10,000 are discarded (warm-up). Table 7 shows a posterior summary for the regression parameters of the model (Table 3).

Table 6. Descriptive statistics by group.

Group	Type	N	Mean	Std. Dev.	Median	Min	Max	Skew	Kurtosis	Std. Error
Control	Pre-Test	70	60.25	14.55	59	28	93	0.1	−0.57	1.74
	Post-Test	70	55.19	15.43	55	18	88	−0.12	−0.38	1.84
	Course Score	70	71.74	7.71	73	55	88	−0.14	−0.54	0.92
Experimental	Pre-Test	79	55.91	13.23	55	17	90	0.1	0.19	1.49
	Post-Test	79	57.04	14.1	58	27	91	0	−0.29	1.59
	Course Score	79	72.90	7.31	74	55	90	−0.31	−0.06	0.82
Total	Pre-Test	149	57.95	13.99	55	17	93	0.14	−0.16	1.15
	Post-Test	149	56.17	14.72	55	18	91	−0.08	−0.26	1.21
	Course Score	149	72.36	7.49	73	55	90	−0.23	−0.28	0.61

Table 7. Posterior summary of the model.

Parameter	Reference	Mean	Std. Dev.	2.5%	97.5%	p (>0 | Data)
β_0	Intercept	−11.12	10.26	−31.17	8.98	0.14
β_1	Pre-Test	0.22	0.09	0.05	0.39	0.99
β_2	Group	1.97	2.17	−2.30	6.19	0.82
β_3	Course score	0.74	0.16	0.42	1.06	1.00

3.3. Teacher Survey Results

The results from the teacher survey can be found in Table 8.

Table 8. Teacher survey results.

Item	Control Group Mean	Std. Dev	Experimental Group Mean	Std. Dev	Total Mean	Std. Dev	Welch *t*-Test	Cohen's d (Effect Size) d	5% CI	95% CI
1	93.38	6.3	95.55	3.52	94.47	4.94	t(6.27) = −0.67, *p* = 0.52			
2	95.14	4.7	95.55	3.52	95.35	3.92	t(7.41) = −0.15, *p* = 0.87			
3	92.63	5.9	95.59	3.39	94.11	4.79	t(6.38) = −0.97, *p* = 0.37			
4	93.36	6.53	94.88	3.93	94.12	5.14	t(6.56) = −0.45, *p* = 0.67			
5	92.22	6.4	94.51	3.62	93.37	5.05	t(6.32) = −0.7, *p* = 0.51			
6	91.16	6.77	94.88	4.3	93.02	5.7	t(6.78) = −1.04, *p* = 0.33			
7	92.13	7.14	95.62	3.86	93.87	5.72	t(6.16) = −0.96, *p* = 0.37			
8	90.86	7.06	94.88	3.93	92.87	5.79	t(6.26) = −1.11, *p* = 0.31			
9	86.19	6.08	94.86	3.52	90.53	6.55	t(6.41) = −2.76, *p* = 0.03	2.18	0.19	4.07
10	91.17	5.28	94.92	4.17	93.05	4.9	t(7.6) = −1.26, *p* = 0.25			
11	92.18	5.93	95.62	3.86	93.9	5.05	t(6.88) = −1.09, *p* = 0.31			
12	92.63	5.9	95.59	3.39	94.11	4.79	t(6.38) = −0.98, *p* = 0.37			
13	80.38	20.57	83.22	3.11	81.8	13.95	t(4.18) = −0.31, *p* = 0.77			
14	66.73	17.04	74.96	4.66	70.85	12.55	t(4.59) = −1.04, *p* = 0.35			
15	68.71	18.44	73.99	4.22	71.35	12.92	t(4.42) = −0.62, *p* = 0.56			
16	89.93	4.32	96.25	3.09	93.09	4.86	t(7.25) = −2.66, *p* = 0.03	1.98	0.17	3.7

The results of the qualitative analysis (i.e., the appraisal analysis) can be found in Supplementary Material S4. These results suggest that the respondents adopt a monoglossic approach [79] as they do not acknowledge any other voices in their discourse. This is expected given the nature of the teacher survey, which is both personal and targeted. In terms of Graduation, the concept of force was only present in the form of intensifiers. This is due to the frequent use of linguistic resources that broaden and intensify meaning, such as very, really, and amazing, among others. More complex structures can be found in the comments submitted by students in the experimental group. These generally look to broaden the meaning given by the author, e.g., "she changed my mind" or "a lovely person".

The comments that were analyzed can be largely grouped into two types: comments on the teacher and comments on the class or methodology.

With regards to the teacher, the students in both the control and experimental groups made positive comments such as excellent, good, empowered, and very clear. One negative comment about the teacher had to do with failing to learn ("I didn't learn how to write an email."). Another negative comment referred to the learning environment ("Some students don't let the class run smoothly.").

It is worth noting that the positive comments about the teacher have a significant impact on the second area that was evaluated (i.e., the class), as she is acknowledged as being the one who managed or enabled this learning environment. There are positive comments about the teacher from both groups of students. However, the students in the experimental group describe more of her attributes, e.g., "She also tries to show you your individual weaknesses", "She was motivated to teach and help get the best out of her students", and "Her sense of vocation is amazing".

The second area that was evaluated was the class, methodology, or learning system. In this sense, the comments are overwhelmingly positive, especially among students from the experimental group: "Her classes are really educational and practical", "It's a really interactive class, which allows for a pleasant environment and this helps when it comes to the assessments", "Really good learning system", "The way the teacher teaches is really educational, while she also tries to show you your individual weaknesses. I hope they show us how get even more out of how we use language". In quantitative terms, only two of the students' comments refer to the class, labelling it as "practical" and highlighting the "pleasant environment". However, none of the other comments referred to this aspect of the course. Instead, seven of the comments made by students in the experimental group focused on the methodology, highlighting it as being educational, interactive, dynamic, attention-grabbing, and as lending itself to generating a positive learning environment.

4. Discussion

A unidimensional model based on our proposed definition of critical thinking explains the structure of the two instruments. Consequently, the pre- and post-tests can be considered equivalent [55,76]. This means that there is one common factor among all items, in this case, critical thinking. The instruments are also validated by having acceptable levels of reliability [62,78] and suitable scores on the item analysis [55,64]. Both instruments are characterized by addressing cultural issues related to the students. This has shown to be a relevant element when designing instruments [35].

The Bayesian linear regression used the pre-test, group, and course scores as variables explaining the post-test scores (see Equation (1)) (Table 7). The results reveal that β_1 (pre-test), β_2 (group), and β_3 (course score) are positive with a very high probability, while β_0 is surely negative. Interpretatively, and taking β_1 as the example, this means that a one-unit increase in the pre-test score implies an average increase of 0.22 in the post-test.

The difficulty index for the items was calculated as the proportion of students who answered the question correctly [64]. As the score for each question was dichotomous, the average score on the test also represents its average difficulty level. In this sense, the post-test can therefore be considered more difficult than the pre-test (Table 6). For the control and experimental groups, this explains the smaller average increase in the post-test scores when compared to the pre-test. When analyzing by group, there is an increase from pre-test to post-test in the experimental group, which is consistent with other studies that show different interventions that were successful in developing critical thinking in community colleges [80]. It is also consistent with specific activities that were included in the proposed methodology, such as open-ended questions and small group discussions, that have also been proved to be successful in developing critical thinking skills in TVET. Therefore, this would suggest that our proposed methodology for developing critical thinking was successful. In the case of the control group, the post-test score was lower than the pre-test score. This may be explained by the increase in difficulty between the two tests.

Furthermore, on average, students in the experimental group scored 1.97 points more on the post-test than students in the control group (Table 7). Therefore, there is a significant

difference in favor of the experimental group. This demonstrates the effectiveness of the proposed methodology for developing critical thinking.

Similarly, it can be seen how a one-unit increase in the course score implies an average increase of 0.74 in the post-test score (Table 7). This is in line with the literature, which suggests that there is a positive relationship between academic performance and critical thinking [63], and would suggest that the methodology not only develops critical thinking but also helps to achieve the expected learning outcomes, which is important, considering the context in which it was developed. A methodology that promotes the development of critical thinking but does not allow the achievement of learning outcomes would have failed nevertheless.

To evaluate which aspects of the methodology were more important when it came to developing critical thinking, the effect sizes based on the students' responses to the teacher survey and the subsequent appraisal analysis can be observed. In this case, there are only significant differences for two of the questions: question 9 ("The teacher shows a willingness to clarify doubts and/or answer questions during class.") and question 16 ("How would you rate your overall experience with the teacher who taught this class?"). The effect size for both of these questions is large [81]. This suggests that the experimental group's perception of the teacher is, in general, better than the control group's perception. There are two possible explanations for this. The first is that having been exposed to this new methodology, the teacher was more willing to help her students in class. The second is that the methodology itself facilitates the teacher's job in the classroom. Any methodology for developing critical thinking must be accompanied by well-planned teaching experiences and sequences that lead to significant learning [26]. This relationship is, therefore, synergistic and cannot/must not be separated. Furthermore, the students' comments show how this relationship comes about, highlighting how aspects such as the teacher's motivation, commitment, and sense of vocation have a positive impact on the learning environment.

Similarly, the appraisal analysis shows how essential aspects of the methodology were highlighted more frequently by students in the experimental group than in the control group when answering the teacher survey. The statement "Her classes are really educational and practical" may relate to the fact that one of the guidelines established for the proposed methodology is that students should work with controversial or real-world topics. This has been highlighted by teachers as being a good way of developing critical thinking [26]. Furthermore, it is especially important for students in technical and vocational education [82].

Furthermore, students in the experimental group highlighted aspects such as the interactive and dynamic nature of the lessons, as well as the positive learning environment. These elements are not highlighted to a similar degree by the students in the control group. This is something that is covered by the main objectives of the methodology and is also intimately linked to engagement. This is because the fact that lessons that manage to grab the students' attention is key to learning [44]. Indeed, this is further supported by one of the students, who suggested that their opinion of the subject changed thanks to the course: "The truth is, in the beginning I wasn't thrilled about taking this class, but your enthusiasm changed my mind". Furthermore, there is also evidence to suggest that the general principles of active learning are related to the development of critical thinking [83]. In this case, active learning is included in the methodology thanks to the objectives relating to active student participation and dynamism, among others. There is also evidence of the positive impact of active learning on employability for students in technical and vocational education [84]. Finally, the importance students place on interactive and dynamic classes can also be explained when considering that they and their families usually have lower levels of motivation [28].

5. Conclusions

The research question asked whether it is possible to develop a methodology for developing critical thinking in technical and vocational education. Considering that the

critical thinking tests used in this study are both valid and equivalent, the results of the Bayesian linear regression model show that our proposed methodology develops students' critical thinking skills more than traditional methods. This is consistent with the proposed methodology for developing critical thinking, given that it was developed based on general recommendations, proven experiences, and activities that have been shown to promote critical thinking in other contexts within higher education [17,85]. The guidelines, methodology, and general structure of a class are outlined in Section 2.3, while a full lesson developed using this methodology can be found in Supplementary Material S1.

Lessons characterized by being interactive, dynamic, and boosting active participation facilitate the teacher's job in the classroom while improving the development of critical thinking. This is particularly true when working with controversial or real-world topics. Several of the activities, methodologies, and principles for developing critical thinking that have been validated in other contexts may also be applicable to technical and vocational education.

This finding also shows that the methodology proposed in this study is a concrete example of how to develop critical thinking in a technical and vocational education and training context. This methodology may also provide a starting point for developing critical thinking for more general purposes, such as developing more productive or critical citizens [20]. This is particularly true considering it contains elements such as the use of real-world examples, discussions, and other activities that can be expanded from specific work skills to more general aspects of life.

The main limitations of our study relate to the experimental design of the sample. All of the participants were students enrolled at the same technical and vocational college in Chile. Furthermore, the students all belonged to the same faculty within the college. Therefore, future work should look to the study of this methodology in different contexts (within the field of technical and vocational education and training) so that the results can be studied in a broader context within this type of education. For example, the study of the relationship between critical thinking and academic achievement in the broader TVET context would provide new reasons to adopt practices for the development of this skill.

Another important factor to bear in mind is the teacher effect. All of the participants in this study (both control and experimental) were taught by the same teacher so as not to let this affect the results. However, this may also mean that the teacher is a factor in the students' development of critical thinking. Consequently, future work should replicate our study with different teachers of different profiles to control for this factor.

Future work should also analyze how to develop critical thinking among TVET students who have undergone this type of intervention. This means considering how these skills may be further developed among TVET students who have already improved their level of critical thinking. In such cases, the context of our study (i.e., TVET as a fallback option, families with low motivation, etc.) may no longer be true [28]. Therefore, there should be research on how the activities for developing critical thinking can adapt and evolve if the characteristics of the subjects change. It should also look at how the sample class designed for our study can be used to plan for and implement the proposed methodology in other courses, contexts, and domains.

Appendix A. Comprehensive List of Critical Thinking Assessment Instruments

Assessment Tool	Theorical Construct	Source
California Critical Thinking Disposition Inventory (CCTDI)	This test contains seven scales of critical thinking: (a) truth-seeking, (b) open-mindedness, (c) analyticity, (d) systematicity, (e) confidence in reasoning, (f) inquisitiveness, and (g) maturity of judgment.	[86]
California Critical Thinking Skills Test (CCTST)	The CCTST returns scores on the following scales: (a) analysis, (b) evaluation, (c) inference, (d) deduction, (e) induction, and (f) overall reasoning skills [15]	[86]
California Measure of Mental Motivation (CM3)	This assessment measures and reports scores on the following areas: (a) learning orientation, (b) creative problem solving, (c) cognitive integrity, (d) scholarly rigor, and (e) technological orientation (Insight Assessment, 2013).	[86]
Collegiate Assessment of Academic Proficiency (CAAP) Critical Thinking	The CAAP Critical Thinking measures students' skills in analyzing elements of an argument, evaluating an argument, and extending arguments.	[86]
Collegiate Learning Assessment+ (CLA+)	The CLA+PTs measure higher order skills including: (a) analysis and problem solving, (b) writing effectiveness, and (c) writing mechanics. The MC items assess (a) scientific and quantitative reasoning, (b) critical reading and evaluation, and (c) critiquing an argument.	[86]
Ennis–Weir Critical Thinking Essay Test	This assessment measures the following areas of the critical thinking competence: (a) getting the point, (b) seeing reasons and assumptions, (c) stating one's point, (d) offering good reasons, (e) seeing other possibilities, and (f) responding appropriately to and/or avoiding argument weaknesses.	[86]
ETS Proficiency Profile (EPP) Critical Thinking	The Critical Thinking sub-skill of this test measures a student's ability to: (a) distinguish between rhetoric and argumentation in a piece of nonfiction prose, (b) recognize assumptions and the best hypothesis to account for information presented, (c) infer and interpret a relationship between variables, and (d) draw valid conclusions based on information presented (ETS, 2010).	[86]
Halpern Critical Thinking Assessment (HCTA)	This test measures five critical thinking subskills: (a) verbal reasoning skills, (b) argument and analysis skills, (c) skills in thinking as hypothesis testing, (d) using likelihood and uncertainty, and (e) decision-making and problem-solving skills.	[86]
Watson–Glaser Critical Thinking Appraisal tool (WGCTA) Standard	The WGCTA is composed of five tests: (a) inference, (b) recognition of assumptions, (c) deduction, (d) interpretation, and (e) evaluation of arguments. Each test contains both neutral and controversial reading passages and scenarios encountered at work, in the classroom, and in the media. Although there are five tests, only the total score is reported.	[86]
WGCTA Short Form and WGCTA II	Measures and provides interpretable subscores for three critical thinking skill domains that are both contemporary and business relevant, including the ability to: (a) recognize assumptions, (b) evaluate arguments, and (c) draw conclusions.	[86]
Critical thinking test in electricity and magnetism (CTEM)	In the context of Electricity and Magnetism, the student will be able to conduct reasoning, argument analysis, hypothesis testing, likelihood and uncertainty analysis, and decision-making and problem-solving.	[87]

Assessment Tool	Theorical Construct	Source
HEIghtenTM critical thinking assessment (HE)	Two central aspects: - Analytical skills: analyzing argument structure, evaluating argument structure, and evaluating evidence and its use. - Synthetic skills: developing valid (structurally strong) or sound (evidentially strong) arguments and demonstrating understanding of the implications of information and argumentation.	[88]
Danczak–Overton–Thompson Chemistry Critical Thinking Test (DOT)	The core principles of critical thinking divided into five sections: inference, assumption identification, deduction, interpreting information, and evaluation of arguments (based on Watson-Glaser Critical Thinking Appraisal (WGCTA).	[57]
Critical and Creative Thinking Test for Portuguese young adults [Teste do Pensamento Crítico e Criativo (TPCC)]	For critical thinking, a combination of what is proposed in Bloom and Facione's taxonomies is used. In specific, the questions are constructed from these skills: interpretation, analysis, explanation, evaluation, summarize, and to produce/create.	[89]
Australian nursing critical thinking tool (ANCTT)	Different real-life scenarios (in a nursing context), where questions are made based on reasoning and analysis. There's no further information about the critical thinking construct used in this assessment.	[60]
The Critical Thinking Assessment Test (CAT)	Four core domains: (a) evaluation of information, (b) evaluation of ideas and other points of view, (c) learning and problem solving, and (d) communication of ideas.	[90]
Physics Critical Thinking Skill Test (PhysCriTS)	Related to critical thinking, several abilities are mentioned: (1) recognizing the problem; (2) finding ways that can be used to solve problems; (3) collecting and compiling necessary information; (4) understanding and using appropriate language, analyzing data, assessing facts, and evaluating statements; (5) recognizing a logical relationship between problems; (6) drawing the necessary conclusions and similarities; (7) examining the similarities and conclusions.	[91]
PAL task "Wind Turbine"	Evaluating and using information according to trustworthiness, relevance, and judgmental error or bias proneness of sources. Recognizing, evaluating, integrating, and structuring arguments and their sub-skills (such as claims, support, beliefs, assumptions, or facts) in response. Recognizing and evaluating consequences of decision-making and actions. Taking communicative action appropriate to deliver results in line with the task prompt, i.e., making an evaluative judgment, explaining a decision, recommending a course of action, suggesting a problem solution, etc.	[61]
Critical thinking instrument of electricity	The test considers six indicators of critical thinking: (1) focus on the question, (2) analyze arguments, (3) consider whether the source is reliable or not, (4) induce and consider the results of induction, (5) identify assumptions, and (6) take action.	[92]
Statistics Critical Thinking Test (SCTT)	In the context of Basic Statistics, the instrument consists of two subtests consisting of interpretation and evaluation.	[93]

Appendix B. Detailed Description of the Pre and Post-Test and Their Items Characteristics

Test	Item	Sub-Skill	Question Type	Item Type	Resource
Pre-Test	MC04_1	Metacognition	Constructed Response	Automatic Scoring	30 s Publicity Advertisement
Pre-Test	MC04_2	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Pre-Test	MC05	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Pre-Test	MC06	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Pre-Test	MC07	Metacognition	Constructed Response	Automatic Scoring	30 s Publicity Advertisement
Pre-Test	MC08	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Pre-Test	AD09	Analysis	Multiple Choice	Short Constructed Response	Informative Text
Pre-Test	IA10	Inference	Multiple Choice	Multiple Choice	Informative Text

Test	Item	Sub-Skill	Question Type	Item Type	Resource
Pre-Test	IR11	Interpretation	Multiple Choice	Multiple Choice	Informative Text
Pre-Test	IR12	Interpretation	Multiple Choice	Multiple Choice	Informative Text
Pre-Test	AD13	Analysis	Multiple Choice	Multiple Choice	Informative Text
Pre-Test	AR14_II	Argumentation	Constructed Response	Multiple Choice	Informative Text
Pre-Test	AR14_III	Argumentation	Constructed Response	Short Essay	Informative Text
Pre-Test	AR14_IV	Argumentation	Constructed Response	Short Essay	Informative Text
Pre-Test	AR14_V	Argumentation	Constructed Response	Short Essay	Informative Text
Pre-Test	IC15	Inference	Multiple Choice	Short Essay	Short Story
Pre-Test	EV16	Evaluation	Multiple Choice	Multiple Choice	Short Story
Pre-Test	IA17	Inference	Multiple Choice	Multiple Choice	Short Story
Pre-Test	IC18	Inference	Multiple Choice	Multiple Choice	Short Story
Pre-Test	AA19	Analysis	Multiple Choice	Multiple Choice	Short Story
Pre-Test	AAIC20	Inference	Multiple Choice	Multiple Choice	Short Story
Pre-Test	AA21	Analysis	Multiple Choice	Multiple Choice	Short Story
Pre-Test	ECO22	Evaluation	Multiple Choice	Multiple Choice	Short Story
Pre-Test	ECR23	Evaluation	Multiple Choice	Multiple Choice	Short Story
Pre-Test	ECO24	Evaluation	Multiple Choice	Multiple Choice	Short Story
Pre-Test	IT26	Interpretation	Multiple Choice	Multiple Choice	Infographic
Pre-Test	AOIT27	Analysis	Multiple Choice	Multiple Choice	Infographic
Pre-Test	ECOIT28	Evaluation	Constructed Response	Multiple Choice	Infographic
Pre-Test	ECO29	Evaluation	Multiple Choice	Short Constructed Response	Infographic
Pre-Test	IA30	Inference	Multiple Choice	Multiple Choice	Infographic
Pre-Test	EOIA31	Evaluation	Multiple Choice	Multiple Choice	Infographic
Post-Test	MC03	Metacognition	Constructed Response	Multiple Choice	30 s Publicity Advertisement
Post-Test	MC04	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Post-Test	MC05_1	Metacognition	Constructed Response	Automatic Scoring	30 s Publicity Advertisement
Post-Test	MC05_2	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Post-Test	MC06	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Post-Test	MC07	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Post-Test	MC08_1	Metacognition	Constructed Response	Automatic Scoring	30 s Publicity Advertisement
Post-Test	MC08_2	Metacognition	Constructed Response	Short Constructed Response	30 s Publicity Advertisement
Post-Test	IR09	Interpretation	Multiple Choice	Multiple Choice	Informative Text
Post-Test	IR10	Interpretation	Multiple Choice	Multiple Choice	Informative Text
Post-Test	IR11	Interpretation	Multiple Choice	Multiple Choice	Informative Text
Post-Test	IT12	Interpretation	Multiple Choice	Multiple Choice	Infographic
Post-Test	IT13	Interpretation	Multiple Choice	Multiple Choice	Infographic
Post-Test	IT14	Interpretation	Multiple Choice	Multiple Choice	Infographic
Post-Test	AR15_I	Argumentation	Constructed Response	Short Essay	Informative Text and Infographic
Post-Test	AR15_II	Argumentation	Constructed Response	Short Essay	Informative Text and Infographic
Post-Test	AR15_III	Argumentation	Constructed Response	Short Essay	Informative Text and Infographic
Post-Test	AR15_IV	Argumentation	Constructed Response	Short Essay	Informative Text and Infographic
Post-Test	AR15_V	Argumentation	Constructed Response	Short Essay	Informative Text and Infographic
Post-Test	IC16	Inference	Multiple Choice	Multiple Choice	Short Story
Post-Test	IC17	Inference	Multiple Choice	Multiple Choice	Short Story

Test	Item	Sub-Skill	Question Type	Item Type	Resource
Post-Test	IC18	Inference	Multiple Choice	Multiple Choice	Short Story
Post-Test	IC19	Inference	Multiple Choice	Multiple Choice	Short Story
Post-Test	IC20	Inference	Multiple Choice	Multiple Choice	Short Story
Post-Test	IC21	Inference	Multiple Choice	Multiple Choice	Short Story
Post-Test	AD23	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD24	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD25	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD26	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD27	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD28	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	AD29	Analysis	Multiple Choice	Multiple Choice	Opinion Column
Post-Test	EV30	Evaluation	Multiple Choice	Multiple Choice	Grammar
Post-Test	EV31	Evaluation	Multiple Choice	Multiple Choice	Grammar

Appendix C

Within Systemic Functional Linguistics, Appraisal Analysis consists of three sub-systems: Attitude, Engagement, and Graduation. The Attitude sub-system includes emotional responses, evaluations of people's behavior, and evaluations of products and processes [79]. This, in turn, consists of three semantic domains: Affect, which refers to expressions of feelings; Judgement, which evaluates people's behavior; and Appreciation, which evaluates objects or constructs aesthetically. The Engagement sub-system is related to the source of the appraisals that is present in the discourse and is sub-classified as Monogloss and Heterogloss. In Monogloss, the authorial voice does not acknowledge other voices in the discourse, while in Heterogloss, there are multiple voices [79]. Finally, the Graduation sub-system acknowledges the possibility of strengthening or weakening an attitude in the discourse using different linguistic resources [79]. All of these aspects were taken into account when analyzing the 32 student comments so as to identify any differences between the control group and the experimental group.

Appendix D

Test	Item	Difficulty	Discrimination	Action
Pre-Test	MC04_1	0.70	0.40	Not eliminated
Pre-Test	MC04_2	0.62	0.35	Not eliminated
Pre-Test	MC05	0.60	0.36	Not eliminated
Pre-Test	MC06	0.21	0.24	Not eliminated
Pre-Test	MC07_1	0.36	0.23	Not eliminated
Pre-Test	MC07_2	0.55	0.44	Not eliminated
Pre-Test	MC08	0.58	0.36	Not eliminated
Pre-Test	AD09	0.80	0.27	Not eliminated
Pre-Test	IA10	0.81	0.25	Not eliminated
Pre-Test	IR11	0.94	0.25	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Pre-Test	IR12	0.92	0.30	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Pre-Test	AD13	0.72	0.26	Not eliminated
Pre-Test	AR14_II	0.71	0.33	Not eliminated
Pre-Test	AR14_III	0.67	0.41	Not eliminated
Pre-Test	AR14_IV	0.38	0.42	Not eliminated
Pre-Test	AR14_V	0.24	0.44	Not eliminated
Pre-Test	IC15	0.59	0.27	Not eliminated
Pre-Test	EV16	0.62	0.22	Not eliminated
Pre-Test	IA17	0.81	0.30	Not eliminated
Pre-Test	IC18	0.78	0.21	Not eliminated
Pre-Test	AA19	0.88	0.23	Not eliminated
Pre-Test	AAIC20	0.45	0.27	Not eliminated
Pre-Test	AA21	0.61	0.28	Not eliminated
Pre-Test	ECO22	0.42	0.26	Not eliminated

Test	Item	Difficulty	Discrimination	Action
Pre-Test	ECR23	0.56	0.34	Not eliminated
Pre-Test	ECO24	0.70	0.19	Not eliminated
Pre-Test	IT26	0.85	0.32	Not eliminated
Pre-Test	AOIT27	0.44	0.37	Not eliminated
Pre-Test	ECOIT28	0.22	0.28	Not eliminated
Pre-Test	ECO29	0.64	0.28	Not eliminated
Pre-Test	IA30	0.41	0.09	Eliminated for having discrimination lower than 0.1
Pre-Test	EOIA31	0.42	0.33	Not eliminated
Post-Test	MC04	0.45	0.29	Not eliminated
Post-Test	MC05_1	0.72	0.21	Not eliminated
Post-Test	MC05_2	0.50	0.27	Not eliminated
Post-Test	MC06	0.27	0.25	Not eliminated
Post-Test	MC07	0.50	0.19	Not eliminated
Post-Test	MC08_1	0.71	0.42	Not eliminated
Post-Test	MC08_2	0.08	0.13	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Post-Test	IR09	0.72	0.39	Not eliminated
Post-Test	IR10	0.92	0.31	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Post-Test	IR11	0.67	0.39	Not eliminated
Post-Test	IT12	0.86	0.27	Not eliminated
Post-Test	IT13	0.85	0.47	Not eliminated
Post-Test	IT14	0.87	0.38	Not eliminated
Post-Test	AR15_I	0.71	0.49	Eliminated for being a Heywood case (factor loading greater than 1)
Post-Test	AR15_II	0.61	0.50	Not eliminated
Post-Test	AR15_III	0.54	0.49	Not eliminated
Post-Test	AR15_IV	0.33	0.49	Not eliminated
Post-Test	AR15_V	0.28	0.48	Not eliminated
Post-Test	IC16	0.64	0.28	Not eliminated
Post-Test	IC17	0.67	0.27	Not eliminated
Post-Test	IC18	0.56	0.32	Not eliminated
Post-Test	IC19	0.63	0.48	Not eliminated
Post-Test	IC20	0.89	0.38	Not eliminated
Post-Test	IC21	0.95	0.36	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Post-Test	AD23	0.37	0.14	Not eliminated
Post-Test	AD24	0.66	0.33	Not eliminated
Post-Test	AD25	0.51	0.34	Not eliminated
Post-Test	AD26	0.55	0.26	Not eliminated
Post-Test	AD27	0.86	0.38	Not eliminated
Post-Test	AD28	0.79	0.35	Not eliminated
Post-Test	AD29	0.72	0.32	Not eliminated
Post-Test	EV30	0.94	0.29	Eliminated for having a difficulty that is not in the 0.1–0.9 range
Post-Test	EV31	0.73	0.22	Not eliminated
Post-Test	EV32	0.93	0.37	Eliminated for having a difficulty that is not in the 0.1–0.9 range

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Soft Skills and Employability of Online Graduate Students

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Abstract: In the current context, with the growing influence of Artificial Intelligence, soft skills emerge as a crucial and distinctive factor for professionals. This research focuses on assessing the relationship between soft skills and their importance in the employability of online graduate students. A mixed methodological, non-experimental and explanatory level approach was used; a sample of 192 online graduate students from a university in northern Ecuador was analyzed. Data collection was carried out through an online survey, validated with a Cronbach's Alpha coefficient of 93.2%. The survey addressed socioeconomic data and the evaluation of soft skills through a 30-question questionnaire with a five-point Likert scale. According to the students' perception, the soft skills most in demand for employability are leadership and teamwork. After the reduction of dimensions using multiple correspondence analysis (MCA), respondents were classified into three clusters. Individuals in clusters one and three developed soft skills such as self-regulation, effective communication, leadership and innovation.

1. Introduction

In the contemporary era, globalization has driven profound and rapid transformations spanning multiple spheres, including disruptive technological innovation, the socioeconomic and political sectors [1], and the educational arena [2]. In response to this dynamic scenario, a growing demand has been observed for professionals who, beyond possessing technical or hard skills, are proficient in interpersonal skills, underscoring the importance of the latter in the labor market [3].

The constant evolution towards a more holistic approach in the training of professionals highlights the importance of adapting not only to the demands of a digitally transformed economy and society [4], but also to the expectations of a constantly changing labor market [5]. In this context, higher education institutions face the challenge of renewing their teaching processes to respond effectively to these requirements [6]. It includes the need to provide specialized education, promote professional development, and foster the acquisition of up-to-date knowledge [4].

In response to the growing demand, the implementation of online master's degree programs emerges as an innovative solution [4]. Online programs offer the possibility of adaptive learning, provide accessibility through mobile devices and time flexibility, and allow adaptation to the challenges of the working world [7] and challenges of the 21st century [5,6].

Therefore, higher education institutions should aim to foster a participatory and dynamic learning environment that prepares students to successfully meet the challenges of the world of work [4]. This implies going beyond technical knowledge; it

is essential to foster the development of soft skills such as communication, teamwork, innovative, and analytical thinking [8–11]. Graduates are expected to exhibit skills in communication, collaboration, leadership, self-discipline, adaptability, teamwork, innovative, and analytical thinking [1,8,9,11]. The skills outlined span the interpersonal, social, and cross-cutting spectrum, are crucial for employability [12], and play a key role in promoting responsible citizenship [13].

Education, as highlighted by Kraja et al. [3], plays a crucial role in the development of social skills, preparing students for a continuous training process that responds to the demands of the labor market and the fulfillment of their tasks [14]. It guides students to adopt versatile and constructive behaviors that facilitate adaptation to change [15,16]. These behaviors are crucial for the development of skills and to expand networking. In contrast, the absence of soft skills often limits individuals in achieving their full potential [17].

Postgraduate education, especially master's degrees, has become crucially relevant in the employment landscape, characterized by increasing competition and the need for highly qualified professionals [3,18], and is capable of providing advanced technical and social skills [19]. However, the fast pace of modern life prevents many people from dedicating time to face-to-face study while working. That is why higher education institutions have developed online specialization programs, which allow professionals to access high-level instruction [20] and, "which makes access to education possible for people who otherwise would not be able to do so" [21] (p. 8). Fajaryati [1] points out that e-learning, also known as E-Learning, has emerged as an alternative widely adopted by professionals seeking to continue their studies at the graduate level.

Therefore, the study of soft skills becomes a fundamental research topic, reflecting its importance in the formation of capable and adaptive professionals for the labor market. In this sense, the objective of this research is to explore master's students' perceptions regarding the importance of soft skills for their employability and professional development. Additionally, it aims to identify groups of online graduate students based on the development of soft skills using cluster analysis and clustering techniques

It is worth mentioning that the institution of study manages an integrative model. This emphasizes flexibility, which allows combining technical knowledge with problem solving, and the projection to entrepreneurship, which brings the student closer to the labor reality, in addition to regulating the application of online education as one of the most important pillars for internationalization [22].

This research is expected to contribute to the understanding of labor market requirements and the role of higher education in fostering professionals equipped with a balanced set of hard and soft skills. It aims to provide results for educational policy makers, higher education administrators, and trainers for the development of educational strategies.

2. Theoretical Background

Since 1993, some authors, but mostly world order agencies, have studied emotion management skills as a fundamental prop to be eligible in a workplace, but, above all, to create stability. Initially, these were called life skills [23]. In Italy, they worked with a conceptual model on how to base and articulate the National System of professional training, which defines them as transversal skills [24]. With a more global action, the European Union (EU) created the Tunning Project and also, through its executive committees, called them generic competencies and key competencies for lifelong learning, also known as transferable skills [25–27]. In 2009, they were established as the skills of the 21st century [28], which is also supported by the Institute for the Future, whose acronym is IFTF, which has conducted several studies since 2011 and called them the skills for the future document, in which it projected their importance for 2020 [29]. The Organization for Economic Cooperation and Development (OECD), since 2012, has determined them as key competencies for the success of life and the proper functioning of society [30]. Manpower group calls them soft skills for talent, and this is the most-used name in current times [31].

Soft skills encompass emotional and social aspects, which enable professionals to perform effectively in the environment [14]. Raciti [32] points out that soft skills are defined as personal attributes, qualities, and habits that improve the capacity for social interaction, highlighting their influence on people's learning, thinking, and behavior [3,12,33]. They are innate or are learned by different experiences and means [33]. They are complemented by hard skills [34], and they provide the plasticity for hard skills to develop and remain current in a changing environment [35]. They are those skills that are not related to a specific task, as they refer to relationships with other people collaborating in the company [35]. They precede hard or technical skills [4]. They go beyond the technical requirements of the profession [36]. These skills facilitate the creation of solid links that promote process flow and contribute to increased productivity.

These skills facilitate strong connections that promote process flow and enhance productivity.

"Soft skills involve multiple stakeholders: providers such as teachers, employers, schoolmates, and colleagues can help develop them." [35] (p. 126). Incorporating soft skills into the curriculum is feasible through didactic methods like project work, simulations, case analysis, educational games, and complementary seminars and workshops [35]. Soft skills are categorized from various perspectives. Grisi [36] classifies them into personal, social, and methodological skills based on common characteristics, as detailed in Table 1.

Table 1. Interpersonal skills.

Personal	Social	Methodological
Learning skills	Communication	Creativity and innovation
Commitment	Customer orientation	Decision making
Professional ethics	Teamwork	Management skills
Tolerance to stress	Leadership	Adaptability to change
Self-awareness	Negotiation	Result orientation
Self-balance	Conflict management	Continuous improvement
Cultural adaptability	Networking	
Research and management skills		

Source: [36].

For Bernstein et al. [37], soft skills are equivalent to three domains of basic skills: autonomous capacity (active learning, autonomous learning, research skills, critical thinking), digital interactivity (digital skills, ingenuity), and ability to work in heterogeneous groups (communication, collaboration). According to Snape [38], higher education students should develop a variety of soft skills to succeed in their professional development. These skills include critical thinking, problem solving, collaboration, adaptability, entrepreneurship, and teamwork. Additionally, communication, information search, and analysis, as well as curiosity and imagination, are also essential. To these are added adaptability, teamwork, work organization, autonomy, results orientation, negotiation skills, and responsibility [39]. The United States Agency for International Development (USAID) [40], for its part, contemplated the development of soft skills in higher education institutions, such as self-management, self-awareness, relational skills, higher-order thinking skills, and communication skills.

Online education has been the subject of numerous studies evaluating its impact on the development of soft skills. Recent research indicates that online education provides a flexible and accessible environment conducive to developing key competencies such as self-regulation, effective communication, and leadership [6,8]. The temporal and spatial flexibility of online programs allows students to develop time management and self-motivation skills, essential for both academic and professional success [7]. García et al. [41] noted that b-learning university environments are effective in developing soft skills, such as comprehension, teamwork, and conscientiousness. These skills are strengthened through blended or remote assignments, where students rotate roles, collaborate, and self-regulate

under the supervision of the lecturer. In this modality, specific competences and evaluation criteria are established to assess the acquisition of these skills.

In addition, there are online platforms that include social skills, which have been shown to be useful in university contexts, facilitating the acquisition of essential social skills for academic and work success [42].

Moreover, online education can enhance communication and collaboration skills through interactive technologies and collaborative learning platforms [38]. Synchronous and asynchronous communication tools, such as discussion forums, videoconferences, and online group projects, facilitate interaction between students and teachers, promoting teamwork and conflict resolution skills [5].

However, some studies have highlighted challenges in online education related to developing certain soft skills. For instance, the lack of face-to-face interaction can limit the development of interpersonal skills and leadership capacity [32]. Additionally, self-efficacy and self-regulation can vary significantly among students, suggesting the need for additional support and specific pedagogical strategies to foster these competencies [6].

The literature also identifies obstacles, which include organizational, contextual and faculty, and student factors [43].

It follows that universities should focus on creating and enhancing soft skills in their students to ensure a successful transition between higher education and professional life [44].

The perception of employers regarding the importance of soft skills is reflected in the increasing inclusion of these competencies in training and professional development programs [45]. A comparative study between students and employers highlights that, while students may underestimate the importance of certain soft skills, employers consider them critical for employability and effective job performance [46]. Employers expect graduates to not only achieve good academic qualifications but also to be equipped with the soft skills necessary for the current workplace environment. Globalization and the growing integration of diverse sectors increase the demand for advanced soft skills in graduates [47].

Regarding technical skills, they are linked to discipline-specific knowledge and focus on the practical application of concepts or tools, such as mathematics, processes, and models, among other examples [2,48]. They enable workers to perform their functions from a mechanical point of view [12].

According to the Organisation for Economic Co-operation and Development (OECD), the development of soft skills in education plays a determining role in employability [30]. This approach is aligned with Sustainable Development Goal 4, which seeks to promote quality education as the premise for training more productive and competitive workers [49].

Along the same lines, the World Labor Organization (WLO) created a manual of activities to improve soft skills [50] based on studies conducted by international organizations such as the Inter-American Development Bank (IDB), World Economic Forum, OECD, Partnership for 21st Century Learning, and The Economist Intelligence Unit, which establishes the soft skills most in demand by organizations, including creativity and innovation, communication, teamwork or collaboration, and leadership focused on results. For the present study, self-regulation, a basic skill for taking online classes, has also been taken into account [30,42,51].

This research adds to the literature by exploring how master's degree students in online programs perceive the importance of soft skills for their employability and professional development. Using a cluster analysis approach, we identify groups of students based on their soft skills development, providing a detailed view of how these competencies are valued and developed in an online educational environment.

Research Questions

In today's dynamic labor market, the importance of soft skills such as leadership and teamwork has increasingly garnered attention, especially among master's students pursuing their studies online. Understanding how these skills influence employability

and professional growth is crucial for educators and students alike. This research aims to address two fundamental questions:

1. What are master's students' perceptions regarding the importance of soft skills, for their employability and professional development?
2. How do online graduate students cluster and differentiate based on the development of studied soft skills using cluster analysis?

3. Materials and Methods

This work was conducted in accordance with the Ethical Guidelines for Educational Research of the British Educational Research Association [52] and the code of ethics of the Northern Technical University [20]. Master's students who voluntarily chose to participate in this study gave written consent. The Research Council of the Northern Technical University (UTN-CI-2023-386-R) approved this study in order to guarantee the confidentiality and anonymity of the participants.

The research employed a quantitative, non-experimental design with an explanatory level. The target population consisted of 230 graduate students, most of whom had completed more than 50% of their study plan and belonged to eight different master's programs. From this population, a representative sample of 192 students was selected using a convenience sampling method from a university in northern Ecuador. Convenience sampling was used due to the ease and speed of accessing available participants at the time of the study.

The technique chosen for sampling was stratified random sampling. This technique was selected to ensure that different subgroups within the population, specifically students from the eight different master's degree programs, were adequately represented in the sample. Stratified random sampling helps in achieving a higher degree of representativeness by considering the proportion of students in each program. This approach minimizes sampling bias and ensures that the findings can be generalized to the entire population of master's students at the university. By using this technique, the study aimed to capture the diverse perspectives and experiences of students across various disciplines, thereby providing a comprehensive understanding of the development of soft skills among graduate students.

For data collection, an online survey was administered, and the instrument was validated using Cronbach's Alpha coefficient, achieving a reliability of 93.2%. The database included 192 observations and 54 variables, with 3 being quantitative and the rest categorical. The survey was structured into two main components: socioeconomic data and soft skills, which included self-regulation, communication, teamwork, focus on results, innovation, and leadership (Table 2). A set of 30 questions was prepared according to Table 2, using a 5-point Likert-type response format ranging from "always" (5) to "never" (1). Higher scores indicate greater mastery of soft skills, while lower scores reflect less skill development.

Table 2. Items to measure soft skills.

Self-Regulation
A1. I plan and organize my academic tasks.
A2. I feel confident setting goals and following a study plan.
A3. I stay motivated and meet deadlines.
A4. I am able to manage stress during assessment periods or assignments.
A5. I maintain a balance between my online academic life with my work and family.
A6. I am persistent in getting help from the instructor through the means of communication established by the online master's program.

Table 2. *Cont.*

Effective Communication
C1. I am comfortable interacting with my online professors and peers.
C2. I participate in online discussions and contribute to academic debates.
C3. When I use my communication skills I resolve a conflict and reach an agreement.
C4. I make sure that my messages are understood in the virtual environment.
C5. I adjust my tone of voice, pace, and gestures when communicating in the virtual environment.

Leadership
L1. I have served as a leader in some project or online study group
L2. I lead and motivate the team to achieve results.
L3. I feel comfortable leading my colleagues in the academic environment.
L4. I have the ability to resolve conflicts and maintain harmony in the team.
L5. I assume responsibility for the results and success of a project.
L6. I value the contributions made by my team members.

Teamwork
T1. I have worked in virtual teams during my online master's program.
T2. I make sure that all team members collaborate in the different academic activities.
T3. I am willing to compromise on my opinions when necessary for the good of the team.
T4. I am willing to compromise on my opinions when necessary for the good of the team.
T5. I adopt the teamwork approach as a means to achieve results.

Innovation
I1. I have participated in online academic projects that require creative solutions or novel approaches.
I2. I am willing to try new ways of learning.
I3. I investigate new self-learning strategies
I4. I am motivated by challenges and problems that require creative solutions.
I5. I am willing to try new ways of approaching problems, even if they are different from conventional ones.

Focus on Results
E1. I am committed to clear goals and objectives.
E2. I am very persistent and do not give up easily, even when faced with obstacles.
E3. My main focus is to achieve measurable and tangible results.
E4. I look for opportunities to learn and improve based on results.
E5. I take responsibility for results and seek solutions when things do not go according to plan.

Relation to Employability
RE1. Do you consider that your level of soft skills may influence your future employability?
RE2. Have you participated in internship programs related to your field of study during your online program?
RE3. Do you believe that your online training can provide advantages in your job search?
RE4. I can apply what I learn in my online master's program directly to my job, which benefits my career.
RE5. Which of the following soft skills do you think are important for employability? Select up to three

Source: [8,36,40].

For data analysis, multiple correspondence analysis (MCA) was used to examine categorical variables. MCA, which is based on the analysis of a multiple contingency table known as Burt's table, allows us to examine the relationships between more than two variables, unlike simple correspondence analysis (SC), which is limited to pairs of variables [53,54].

The technique decomposes the Burt matrix using eigenvalue decomposition to discover patterns of association between variables. These patterns are presented in a two-dimensional space and illustrated through a biplot graph, facilitating the visualization of the relationships between the different categories of data [55,56].

To group the data, cluster analysis was applied according to the similarity of their characteristics, without prior supervision. This exploratory method aims to identify natural structures and patterns, organizing the observations into clusters where each group is more homogeneous internally than with respect to others. Several measures of distance and association were used, such as Euclidean and Manhattan distance, in addition to Pearson's correlation to define similarities [56].

The analysis was applied in a multidisciplinary context, focusing on hierarchical techniques for detailed classification of the data. These methods build a hierarchy of clusters, where at each step of the process, observations or clusters are grouped based on their similarity, and this grouping is represented in a tree structure or dendrogram [53,54].

4. Results

4.1. Socioeconomic Analysis

Table 3 presents a breakdown of social, educational, and economic frequencies of the population sample. The descriptive statistical analysis indicates that in the distribution of the sample, the female sex predominates with 57.3%, compared to 42.7% male participation, showing a greater inclination towards female participation in the educational context considered. Regarding marital status, the data reveal that most of the respondents are single, followed by married.

Segmentation by educational modules shows a significant concentration in the seventh module, with 49.0% of the respondents, which could indicate an advanced stage of education in the sample. Regarding the academic level, most of the respondents, 84.9% of the participants, have a bachelor's degree. A minority are pursuing their second master's degree.

Table 3. Social, educational, and economic frequencies.

Variable	Description	Frequencies	% of Total	% of Cumulative
Sex	Male	82	42.7%	42.7%
	Female	110	57.3%	100.0%
Marital Status	Married	67	34.9%	34.9%
	Divorced	14	7.3%	42.2%
	Single	98	51.0%	93.2%
	Unmarried	13	6.8%	100.0%
Age	Average	35 years old		
Educational Level	Master's Degree	29	15.1%	15.1%
	Third Level	163	84.9%	100.0%
Master's Degree Program	Business Administration with mention in competitiveness and quality management	21	10.9%	10.9%
	Visual Arts	12	6.3%	17.2%
	Computer Science with mention in Computer Security	13	6.8%	24.0%
	Communication, mention in Digital Communication	11	5.7%	29.7%
	Local Development with specialization in social and solidarity economy projects	15	7.8%	37.5%
	Finance, with mention in Financial Management	27	14.1%	51.6%
	Occupational Health and Hygiene	59	30.7%	82.3%
	Educational Technology and Innovation	34	17.7%	100.0%

Table 3. *Cont.*

Variable	Description	Frequencies	% of Total	% of Cumulative
Module	Fifth	43	22.4%	22.4%
	Sixth	55	28.6%	51.0%
	Seventh	94	49.0%	100.0%
Type of employment	Private employee	80	41.7%	41.7%
	Public employee	92	47.9%	89.6%
	Unemployed	20	10.4%	100.0%
Workload	Part-time	9	5.2%	5.2%
	Full time	152	88.4%	93.6%
	Part-time (less than 4 h)	11	6.4%	100.0%
Monthly income	1351–1800	17	9.9%	9.9%
	1801–2250	0	4.7%	14.5%
	451–900	71	41.3%	55.8%
	901–1350	64	37.2%	93.0%
	More than 2251	3	1.7%	94.8%
	Less than 450	9	5.2%	100.0%
Work Experience	4 years or more	119	69.2%	69.2%
	Between 1 and 3 years	41	23.8%	93.0%
	Less than 1 year	11	6.4%	99.4%
	None	1	0.6%	100.0%
Job level	Operational	29	16.96%	16.96%
	Administrative	114	66.67%	83.63%
	Middle management	17	9.94%	93.57%
	Authority	9	5.26%	98.83%
	Members of Board	0	0.00%	98.83%
	Own business	2	1.17%	100.00%

The distribution by master's degree program shows a marked preference for the Occupational Hygiene and Health program (30.7%) and Educational Technology and Innovation (17.7%), which could suggest an inclination towards fields related to health and educational technology. These programs, along with Finance, with a mention in Financial Management (14.1%), represent the predominant areas of interest among the graduate students surveyed.

Regarding economic factors, the majority of the master's students are working in the public (47.9%) and private (41.7%) sectors. The predominant positions are in administrative (66.66%) and operational (16.96%) areas of the entire population, having a full-time load in their respective jobs (88.44%). The salary range oscillates between USD 451.00 and USD 1350, which may mean that developing the master's program can be used as a tool to access better remuneration and climb professional positions.

4.2. Perception Regarding Employability

Master's students' perceptions of the importance of soft skills for their employability are shown in Figure 1. The results suggest that students value first and foremost a focus on results, followed by leadership. At the same level, teamwork, effective communication, and innovation stand out. Finally, there is self-regulation. These findings highlight the importance of integrating the development of soft skills into master's programs in order to fully prepare students for today's labor market.
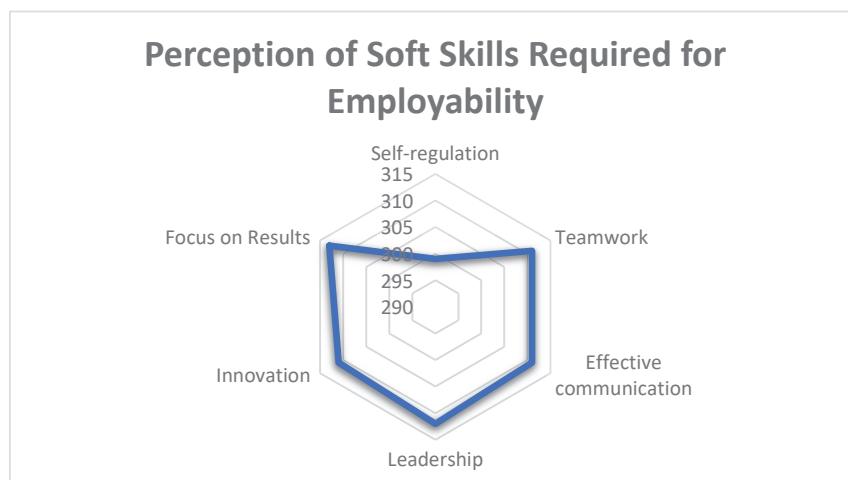
Figure 1. Perception of soft skills required for employability.

4.3. Clusters and Cluster Analysis

First, this technique allows for the identification of homogeneous groups within a data set, facilitating the understanding of how soft skills are distributed and related among online graduate students. By grouping students according to similar characteristics, patterns and trends that might otherwise go unnoticed can be identified.

In order to evaluate the relationship between soft skills in the academic development of the students, a cluster analysis was carried out.

Since 49 categorical variables are treated as a multivariate description, we proceeded to reduce dimensions with the technique known as multiple correspondence analysis (MCA). Once the MCA was adjusted, the optimal number of clusters to be retained was determined using Ward's method for grouping. See Figure 2.
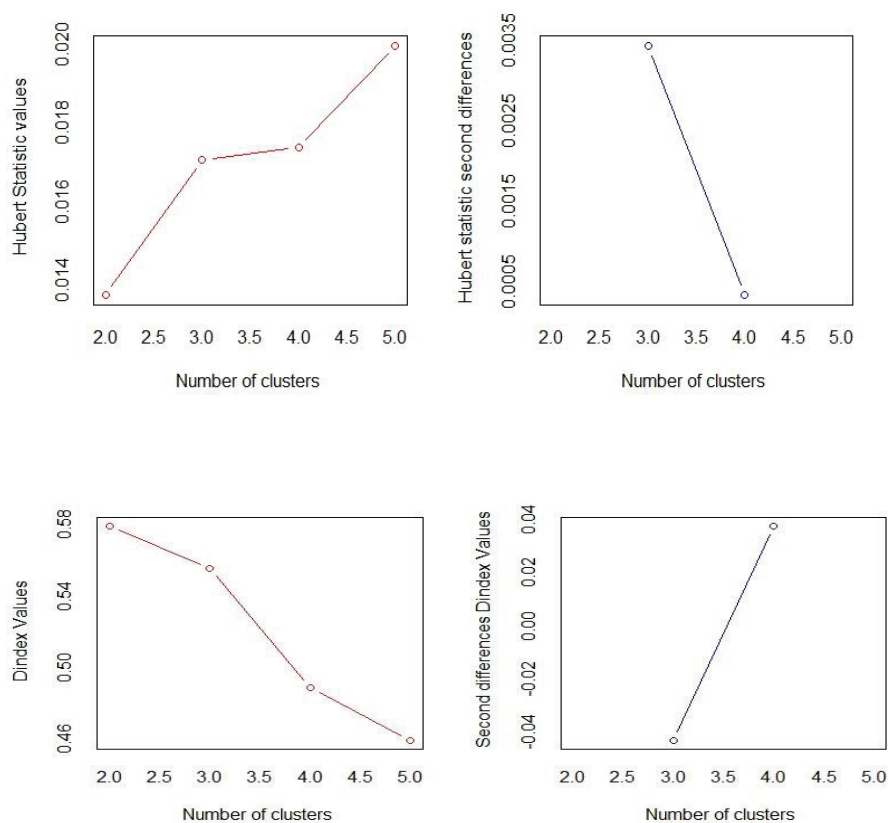
Figure 2. Number of clusters.

According to the majority rule, the optimal number of clusters is three; thus, the HCPC was set to group into three clusters.

The previous dendrogram (see Figure 3) shows that of the 192 individuals sampled, Group 1 in red includes 113, followed by Group 3 in blue, which includes 78, and finally the second group, which is a unitary grouping, as can be seen in Figure 4:
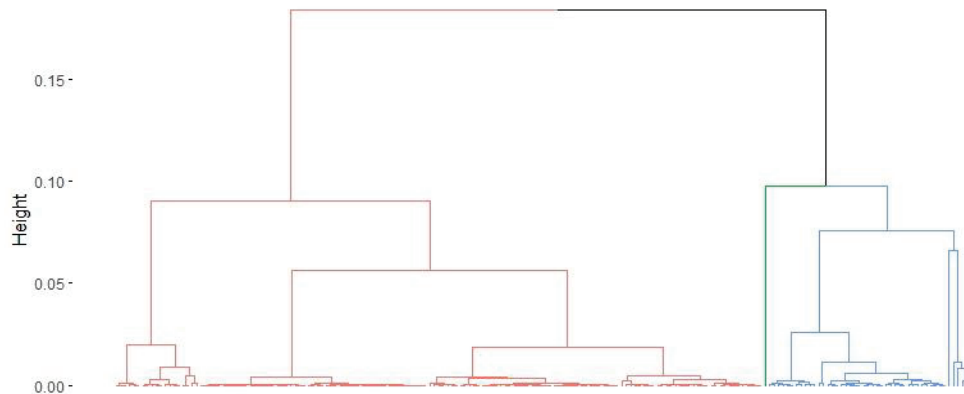
Figure 3. Number of clusters.
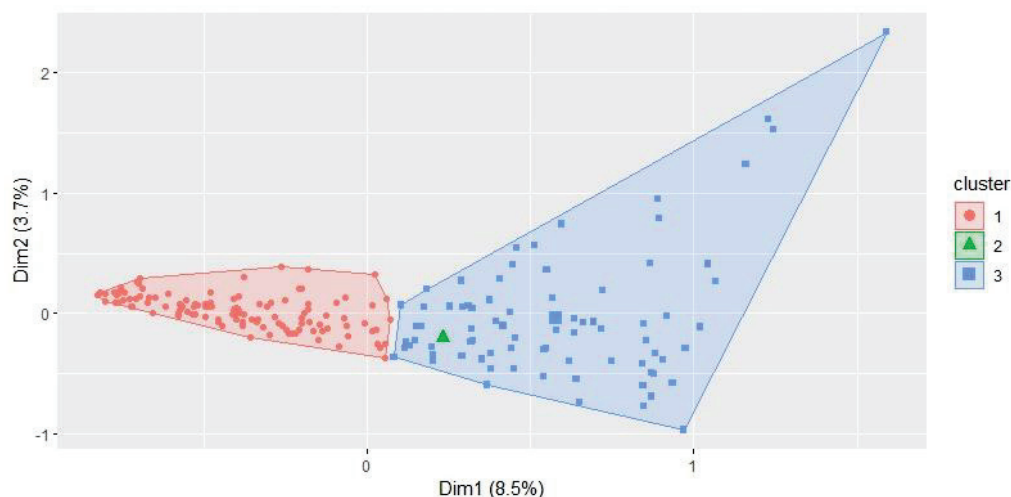
Figure 4. Biplot diagram.

The previous diagram is known as a biplot (Figure 4), which shows that only 12.2% of the total variance is captured, added between dimension one and dimension two. The three groups mentioned in Figure 3 can be distinguished. It is observed that Groups 1 and 3 are well defined, while Group 2—green triangle—overlaps with Group 3.

The aforementioned Figure 4 aims to visually illustrate the classification of the students into the different groups based on the cluster analysis. The narrative following the figure indeed focuses on describing the analytical technique used (multiple correspondence analysis and Ward's method) to provide a clear context for the methodological procedure and the validity of the clustering.

4.4. Characterization of the Clusters

With the chi-square test X_q^2, which evaluates the association between the cluster variable and the specified categorical variables, the null hypothesis states: H_0: there is no association between the variable and the cluster (see Table 4).

Table 4. Codification H_o.

Codification	p Value df	Df
I4	6.109994×10^{-56}	6
C1	8.090437×10^{-56}	8
RE3	6.799142×10^{-45}	8
I3	3.539869×10^{-29}	8
C2	1.093557×10^{-21}	8
I1	3.084466×10^{-19}	8
A2	4.486824×10^{-18}	4
I5	2.502999×10^{-17}	4
L4	3.617609×10^{-17}	6
I2	1.309980×10^{-16}	4
A4	1.908496×10^{-16}	6
L3	9.654197×10^{-16}	4
E4	1.217821×10^{-15}	4
E5	5.574846×10^{-15}	4
C3	8.638790×10^{-15}	6
T4	3.520501×10^{-14}	4
RE5A	3.549690×10^{-14}	4
E3	1.932687×10^{-13}	4
C4	5.497301×10^{-13}	4
A1	3.293529×10^{-12}	6
RE4	7.160699×10^{-12}	6
E2	2.934836×10^{-11}	4
E1	5.407635×10^{-11}	4
L5	7.397468×10^{-11}	4
T2	1.543442×10^{-10}	6
C5	1.619074×10^{-10}	8
L2	1.770758×10^{-10}	8
A5	1.807214×10^{-10}	4
T1	2.395859×10^{-10}	6
RE5I	8.476282×10^{-9}	4
A3	2.246374×10^{-8}	6
RE1	2.844637×10^{-7}	6
L1	1.043266×10^{-6}	8
RE5T	6.165680×10^{-5}	4
T3	2.429748×10^{-4}	6
RE5L	6.925417×10^{-4}	4
RE5C	1.058441×10^{-3}	4
RE5E	2.038651×10^{-3}	4

As can be seen, the *p*-values of the above variables are less than the significance value ($\alpha = 0.05$), which is 5%. this suggests that the categorical variable can be useful to differentiate between the clusters. In this case, 38 out of 47 variables chosen are significant, i.e., they are useful for clustering.

4.5. Cluster One: Self-Regulation, Effective Communication, Leadership, and Innovation

This group consists of students who show high levels of self-management, effective communication, leadership, and innovation. The description includes demographic details to highlight that these students, for the most part, belong to the Masters in Finance with a focus on Financial Management, and have an average age of between 39 and 47 years. This suggests that more experienced students, probably already involved in the financial sector, tend to value and develop these soft skills

4.6. Cluster Two: Demotivation, Outlier

Although this group only includes one student, it stood out due to its particular characteristics of demotivation and low interaction in online environments. This student does not

perceive advantages in the job search derived from his master's program and shows a low application of soft skills in his current work context. This case was described to illustrate the variability in soft skills development and its impact on perceived employability.

4.7. Cluster Three: Self-Regulation, Effective Communication, Leadership, and Innovation

The third group is composed of students with moderate levels of self-management, effective communication, leadership, and innovation. The brief description was due to the fact that, although they share similar characteristics with Group 1, their levels of soft skills are not as high. This group includes students from a variety of master's programs, with no clear predominance in terms of specific demographic characteristics. However, they are mostly students from education and technology-related programs, which may influence the assessment of certain soft skills.

4.8. Demographic Characteristics and Valuation of Soft Skills

In response to the request about which types of students value which types of soft skills, we note the following:

– Students in finance programs (mainly in Cluster One) tend to highly value self-management, effective communication, leadership, and innovation. This may be related to the competitive and dynamic nature of the financial sector, which requires strong leadership and management skills.
– Students in education and technology programs (predominantly in Group 3) moderately value these same skills, possibly due to the need to apply them in teaching and technology development contexts, where innovation and effective communication are essential but not as strongly required as in the financial sector.

The groups described were selected for their representativeness and distinctive characteristics in soft skills development. Group 1 and Group 3 were the most representative in terms of size and soft skills variability, while Group 2, although in the minority, provided a significant contrast by showing a profile of demotivation and low interaction. The selection was made to provide a comprehensive and diverse view of how different demographic and academic factors influence the valuation and development of soft skills

The cluster analysis showed that soft skills significantly influence students' academic and professional development. The identification of these clusters provides a more detailed understanding of how these competencies are distributed and related among students in online master's programs, highlighting the need to integrate soft skills development into educational curricula to improve graduates' preparation for the labor market.

5. Discussion

According to the results of this research, students perceive that the most important soft skills for employability are results orientation, followed by teamwork. However, there is greater evidence of development in self-regulation, effective communication, leadership, and innovation. This is not contradictory, as achieving effective results and working well in a team necessitate having these developed skills.

These findings are similar to those of other studies conducted by various authors and multilateral organizations, which emphasize that hard skills alone are insufficient for professional success in dynamic workplaces. Ummatqul Qizi [5] pointed out that self-awareness skills are paramount, while stress tolerance and adaptation to change are less significant. These results are consistent with the findings of this study.

Employers' perception of the importance of soft skills is reflected in the increasing inclusion of these competencies in training and professional development programs [45]. A comparative study between students and employers highlights that while students may underestimate the importance of certain soft skills, employers consider them critical for employability and effective job performance [46]. Employers expect graduates to not only achieve good academic qualifications but also to be equipped with the soft skills necessary

for the current workplace environment. Globalization and the growing integration of diverse sectors increase the demand for advanced soft skills in graduates [46].

The OECD, EU, Tuning Project, and World Economic Forum have given value to the development of soft skills as a mainstay for employability, and especially to achieve job stability and internal promotion, and, at the same time, improve the productivity of organizations. The skills highlighted for employability are leadership, teamwork, focus on results, innovation, and self-regulation, which are also called emotional intelligence [25,26,30,51]. In the paper entitled "The role of soft skills in business students towards graduate employability", the soft skills highlighted for employability are communication, leadership, and teamwork [57], which corroborates the information of the present research.

The multivariate description of the 192 respondents shows that 191 of them perceive that they have developed soft skills after completing the master's programs at the Universidad Técnica del Norte. The skills they perceive they have are effective communication, self-regulation, leadership, and innovation. Volkova [58] identified that skills such as communication, self-regulation, cognitive, strategic, and management skills are essential to stand out professionally, highlighting the potential of leadership, innovation (openness), proactivity, and self-control, among others. These findings are consistent with the contributions by Hagen and Bouchard [59] and Laguna-Sánchez [39], who also underline the relevance of these capabilities.

However, it is important to note that research regarding the assessment of soft skills and their impact on the employability of graduate students in online modalities is still limited [60]. One of the limitations of this study is that respondents may have provided answers that they consider socially desirable or that reflect their personal perceptions, rather than an objective assessment of their abilities. In addition, the survey was administered to a specific sample of online graduate students at a university in northern Ecuador, which limits the generalizability of the findings to other populations or educational contexts.

This gap in the literature suggests the need for future research that delves deeper into how these skills are developed and assessed in virtual education contexts and how they influence graduates' transition to the labor market. Such an approach would not only enrich the existing body of knowledge on the subject, but would also offer practical guidelines for the implementation of educational and professional training strategies adapted to the demands of the 21st century.

6. Conclusions

Based on this literature review, it can be concluded that soft skills play a fundamental role in the formation of competent and capable professionals for the labor market. Various applied studies in companies and reports from international organizations have highlighted the importance of these competencies in employability, emphasizing that their development in higher education is crucial for preparing students for the challenges of the current professional world. Thus, the implementation of educational programs that integrate the development of soft skills is essential to enhance the job placement of graduates.

Students' perceptions of the link between their soft skills and their employability opportunities correlate closely with previous research findings, underscoring the critical importance of these skills not only for individual success, but also for their contribution to the broader socioeconomic fabric. The results of this assessment emphasize the relevance of soft skills within the educational process, highlighting the need for their deliberate incorporation into higher education curricula to meet the changing demands of the work environment.

Employers' perception of the need to develop soft skills is clear and strong. These competencies complement technical skills and enhance individuals' ability to contribute effectively in their professional roles. Continuous collaboration between the educational sector and the labor market is necessary to align the skills taught with the real demands of work, thus promoting a more competent, ethical, and collaborative work environment.

The most notable traits of candidates who have developed their soft skills are evident in the emotional intelligence they demonstrate, as well as in their performance, maturity, and speed in facing challenges.

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Article

Quality Evaluation Model of Vocational Education in China: A Qualitative Study Based on Grounded Theory

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Abstract: Enhancing quality is the focus of vocational education reform, and building a quality evaluation system that is adapted to the needs of modern vocational education is an important task of vocational education reform. However, international research on quality evaluation models of vocational education has still not been explored in depth. In order to reveal the influencing factors and the relationships between them in the quality evaluation system of vocational education in China, this study establishes a theoretical model of quality evaluation of vocational education in China and tests the model. Based on in-depth interviews, this study reached the following conclusions: (1) Educational orientation is the starting and ending point of vocational education quality evaluation. The quality evaluation of vocational education in China is directly reflected through professional settings and talent training objectives; (2) the quality evaluation of vocational education in China focuses on factors external to the education system, which is an important means through which the quality of vocational education can be recognized by the public, enterprises, and industries; (3) there are internal factors influencing the quality evaluation of vocational education, namely institutional resources and evaluation system construction. In addition, strategies for vocational institutions are proposed based on the study results, suggesting that other countries should strictly regulate the settings of majors based on the real needs of industries; promote the development of technical knowledge, teaching materials, and teacher training; and explore the function of international exchange and cooperation, industry–education integration, and school–enterprise cooperation in educating people. This study provides a theoretical model for the quality evaluation of vocational education; in terms of practical value, the constructed model extends the scope of basic theory.

Keywords: vocational education; quality; evaluation model; influencing factors; grounded theory

1. Introduction

Enhancing quality is a key concern of vocational education in the world. Building a quality evaluation system and quality evaluation model to meet the development needs of China's modern vocational education system is also an important strategic task for China's vocational education reform. Throughout the world, the overall scale of vocational education is on the rise, with different countries and regions showing different volumes and growth momentum according to their own macro policies, economic development levels, changes in labor supply and demand, and the degree of informationization. According to the "Global Vocational Education Industry Development Report 2022" released by Ariadne Consulting in July 2022, despite the emergence of the global new crown pneumonia epidemic, political landscape turmoil in various countries, and extreme natural disasters in recent years that have brought certain negative impacts on the global economy, the global vocational education market size is expected to expand to 2026 under the macro background of positive global vocational education development, exceeding USD 800 billion [1]. From 2012 to 2022, vocational education in China trained 61 million high-quality workers and technically skilled personnel for various industries [2]. In China's modern manufacturing, strategic emerging industries, and modern service industries, more than

70% of the new front-line workers are graduates of vocational colleges [3]. The reason why vocational education in China plays such a huge employment function cannot be separated from the help of vocational education quality evaluation. Transforming the way vocational education is developed and building a vocational education quality evaluation model with Chinese characteristics and international standards is the current direction of development in China. However, from the perspective of the impact of international economic transformation and digital industrial upgrading on vocational education, the process of reform and development of vocational education in China is facing many problems: the Chinese government is not performing its duties properly and the policy implementation mechanism is not sound; Chinese industrial organizations and enterprises are not active enough to participate in vocational education and the cooperation between schools and enterprises lacks a long-term mechanism; the attractiveness of vocational education within the Chinese public is not enough, etc. In China, the choice of secondary vocational education in urban areas was 44.63%, 32.48%, 36.21%, and 35.31% in 2008, 2011, 2013, and 2017, respectively, while the choice in rural areas was 29.49%, 21.57%, 30.00%, and 33.02%, respectively, all of which were lower than in OECD countries' high school vocational education. The percentage of graduates in upper secondary vocational education is lower than the average values in OECD countries [4]. To solve the above problems, it is inevitable that the whole society pays more attention to the improvement of the quality of vocational education, and a scientific quality evaluation model can be the lifeline of vocational education.

Faced with the pressure of enrollment and the social image caused by the Chinese public's lack of confidence in vocational education, the development of vocational education in China must be upgraded and transformed under the premise of demanding quality improvement [5]. Generally speaking, the development of quality education is usually associated with the cultivation of talents and the curriculum and professional settings. As the pace of China's industrial transformation advances, the talents cultivated by vocational education are given the significance of the times to contribute to economic development and industrial production. Unlike general higher education, the quality of vocational education does not focus too much on the mastery of advanced knowledge, but more on the proficiency of skills and the ability to solve real-world problems [6]. Focusing on vocational education, from the perspective of enrollment, only students with low academic performance will choose to enter secondary schools or higher vocational colleges because of the prejudice of the Chinese public towards vocational education, hence the quality of enrollment in vocational education is low [7]. From the perspective of graduation, the duration of education in higher vocational colleges in China is three years—one year less than in ordinary universities—and students in vocational colleges also undertake a higher number of internships [8]. The quality of graduates from vocational colleges is generally considered to be "low" because of the three-year duration of education in higher vocational colleges in China, which is one year less than in ordinary universities. Numerous studies have proved that establishing an effective internal quality control system in vocational colleges, including assessment indicators of curriculum design, teaching processes, teaching objectives, teaching effectiveness, teaching methods, and other elements, will effectively monitor the internal and external qualities of vocational colleges, which will contribute to the sustainable development of vocational education. Building a perfect quality evaluation model for vocational education is not only necessary for improving the quality of vocational education talent training but also an important manifestation of people's pursuit of satisfactory education, which needs to be focused on urgently. Whether high-quality development of vocational education can be achieved is not only linked to the survival and development of vocational institutions themselves but also to the overall development of China's education system, economic and social development, and social atmosphere. Therefore, this study explores the influencing factors involved in the quality evaluation of vocational education in China and explores the relationships and mechanisms through which these factors influence each other, which have important theoretical and practical

values in enriching and expanding the theory of vocational education quality evaluation and formulating scientific, standardized, and systematic quality evaluation models.

However, existing studies have not revealed the factors influencing vocational education quality evaluation, hence this study aims to develop a theoretical model to reveal these factors and the mechanisms influencing these factors in an attempt to answer the questions: what are the factors that influence the quality evaluation of vocational education in China? What is the relationship between these factors? What are the strengths and weaknesses of China's vocational education quality evaluation model? The above three questions are the main issues that need to be addressed in this paper. On this basis, this paper took the management, teachers, and students of 32 vocational institutions as the research subjects, collected interview data from them, and organized the data for analysis. This study then established a theoretical model using the grounded theory method, laying the foundation for subsequent research.

This study has theoretical contributions and practical value: in terms of theoretical contribution, this study enriches the theory of quality evaluation of vocational education and provides a theoretical model for quality evaluation of vocational education operation and talent training; in terms of practical value, the quality evaluation model constructed in this study provides a reference for subsequent studies and extends the scope of the basic theory, while also providing a reference for the government and schools to formulate relevant policies and regulations. In terms of practical value, the quality evaluation model constructed in this study provides a reference for subsequent studies and extends the scope of basic theory.

This paper is divided into five sections, and the main contents of the remaining four sections are as follows: Section 2 is the literature review; Section 3 is the research methods and data, where the research methods and data sources used in this study are presented; Section 4 is the analysis of the findings, where the model and its internal factors and relationships are explained; Section 5 is the conclusions and outlook, where the main conclusions, research limitations, and future prospects of this study are presented.

2. Literature Review

Quality evaluation elaborates on the specifics of vocational education curriculum development, instructional settings, and faculty development [9], which play an important role in the process of vocational education system construction. This study focuses on the quality development of vocational education and comprehensively arranges the relevant literature in terms of the definition and connotation of quality evaluation of vocational education, the factors influencing quality evaluation, and the interactions between the factors "quality education and enhance lifelong learning opportunities for all" [10]. In this context, vocational education is often considered necessary for building a new quality assessment system for addressing the dual development of economic growth and individual technical skills enhancement [11]. Therefore, it is possible to systematize the indicators, influencing factors, and constructs of vocational education quality evaluation by considering both economic and individual factors.

2.1. Quality Evaluation Indicators and Factors Influencing Vocational Education

Before research was carried out on the quality evaluation of vocational education, international research on vocational education focused more on the quality of personnel training. Many studies have reached a consensus that the quality of personnel training is the core issue in deepening education and teaching reform and improving education quality, and is the lifeline of vocational education [12]. With the differentiation of academic education from skill education, academia began to focus on research on vocational education quality evaluation [13]. In the study of vocational education quality evaluation indicators and influencing factors, researchers have analyzed quality evaluation indicators of vocational education development in different countries or regions from multiple perspectives, and these indicators are widely influential and play the role of "overall leadership" in the

relevant studies. In terms of the selection of evaluation indicators, there are two tendencies: Baxter (2013) [14] considers the quality of vocational education as the extent to which vocational education meets the needs of society. However, there are some researchers who focus on the individual growth research perspective and believe that the purpose of vocational education quality evaluation is to enhance the quality of talent development. For example, Billing (2004) [15] suggests that the quality of vocational education needs to be understood and interpreted from the perspective of technical literacy development of skilled personnel from an individual perspective and proposes four dimensions—technical thinking, technical behavior, technical attitude, and technical culture—to examine the quality of vocational education personnel training. At the same time, there are studies that integrate the above-mentioned perspectives and consider that the factors influencing vocational education quality evaluation involve internal fitness quality, external fitness quality, and humanistic quality (Forrest et al., 2013) [16]. Although some researchers have tried to explore the factors influencing the quality evaluation of vocational education, there is some room for research in these studies. This is because they do not take into account the differences between vocational education and general education. The dimensions involved are still approached from the internal and external perspectives of education, and they cannot reveal the factors influencing the high-quality development of vocational education. Many scholars have shown that vocational education involves multiple subjects and cannot be studied only from the internal perspective of education (Asiri, 2020) [17]. The quality evaluation of vocational education is bound to involve different subjects, such as education, enterprises, industries, third-party organizations, and research institutions. Therefore, we must be conscious that the construction of the quality evaluation index system for vocational education must be based not only on economic functions but should also fully consider individual needs.

2.2. Research on the Constructs of Vocational Education Quality Evaluation

Focusing on the construction of quality evaluation in the field of vocational education is an important part of improving the quality of talent training and a key step in judging the comprehensiveness, relevance, and effectiveness of vocational education reform efforts [18]. Vocational education is the type of education that is most directly connected with industrial transformation and upgrading and is closely associated with people's production and life. The quality evaluation of vocational education has received much attention from international researchers in recent years and has been researched continuously through various means. In terms of the concept of vocational education quality evaluation, Wergin (2005) [19] proposes four quality evaluation views of vocational education: demand-oriented, diversified, "competence-based", and moral education-oriented through a multi-program decision-making approach [20]. After discussing the concept of evaluation, the principle of constructing the evaluation index system is the operationalization of the concept on the ground. In the principle of constructing the evaluation index system, Hongliang (2015) [20] believes that the principles of scientificity, professionalism, comprehensiveness, and feasibility should be followed when constructing the talent cultivation quality evaluation system. Unlike relevant studies in China, international studies use more scientific research methods and pay more attention to the principles of multidimensional constructs. Ewell (2011) [21] proposed the evaluation principles of combining universality and specificity, evaluation and rating, science and practicality, precision and fuzziness, and static and dynamic for the evaluation of talent training quality in engineering majors. In addition, Song (2012) [22] summarized the principles of talent cultivation quality evaluation in vocational education as "one center and four combinations" centering on the cultivation of talents for sustainable development in vocational education, combining quantitative evaluation with qualitative evaluation, process evaluation with final evaluation, multiple evaluations with development evaluation, and skill evaluation with quality evaluation. On the whole, the above research shows that the academic community has

constructed evaluation models based on scientific methods, but this is still at a relatively preliminary stage.

2.3. Research Review

In the context of countries competing to enhance the international competitiveness of their industries, the quality of vocational education has become an inevitable topic. However, the limited literature has explored the connotation, essence, indicators, and other elements of vocational education quality evaluation as a sample of empirical studies. For vocational institutions in different regions, at different levels, and with different schooling characteristics, there are significant differences in the construction choices and realization paths of the quality evaluation system due to the differences in the foundations of schooling and talent cultivation, the path dependence of development, and the different sensitivities and requirements for various conditions in schooling. Existing studies have not systematically explored the factors influencing the vocational education quality evaluation model and the relationships between them based on the development characteristics of vocational institutions. The influencing factors and each factor of the vocational education quality evaluation model are key to the cultivation of technical skill talents, which not only determines the direction of development of vocational education but also limits the degree of investment in the curriculum and teaching in vocational education (Xiaohua, L.; Xihui, C., 2022) [23]. In the current context of gradual global economic recovery, promoting the quality of technical skill talents through high-quality development of vocational education is a key move in accelerating the industries of each country to break the development deadlock. How to establish a systematic, scientific, and comprehensive vocational education quality evaluation system to help vocational colleges and universities to better cultivate technical skill talents? How to improve the accuracy and effectiveness of the training of talents? Ensuring the sustainability of policy support in each country in the future is important. In addition, the following points, in particular, need special attention.

(1) Relevant research on quality evaluation of vocational education has achieved relatively mature results in the construction of evaluation index systems; however, the research on quality evaluation of vocational education focuses mainly on its economic functions, and research involving individual development is not systematic and in-depth enough, and does not specifically reveal the systemic and complete nature of the quality evaluation of vocational education. At present, the corresponding research results are mainly distributed between the evaluation principles and main indicators, and the deep-level quality evaluation factors are insufficient.

(2) Research on the current state of vocational education quality has yielded good results, but research on quality evaluation is limited, especially since current research is still borrowed from the field of general education and lacks relevance. Therefore, the evaluation of the quality of vocational education should include several different dimensions such as economic factors, personal factors, and technical factors. Meanwhile, in terms of research methods, the scientific methods and evaluation principles used in academia should be considered as the basis for the construction of evaluation models; however, due to the relatively mixed research in the field at present, the existing methods on the evaluation factors of vocational education quality and their scientific construction are not clear. Therefore, this study attempts to fill the methodological gap by building on the literature review. Specifically, this study will reveal the relationships between the influencing factors and factors of vocational education quality evaluation by conducting an in-depth analysis of interview materials on vocational education quality evaluation using the grounded theory approach.

(3) Analysis of studies on the evaluation of the quality of vocational education reveals that the topic has been on an annual increase. However, research on the quality evaluation of vocational education is not systematic and in-depth enough, and empirical studies are particularly scarce. Most of the existing studies are qualitative studies exploring the factors influencing the quality evaluation of vocational education, and there are no

strong, evidence-based studies. Compared with related international studies, China has more room for theoretical breakthroughs in this area. Therefore, this paper takes the quality evaluation system of vocational colleges as the research objective and tries to construct a quality evaluation model suitable for the development of high-quality vocational education using the grounded theory approach.

In view of this, this study constructs a quality evaluation model that helps to improve the quality of vocational education based on the characteristics of vocational institutions and their talent cultivation environments, and conducts in-depth interviews on the quality evaluation system of vocational education using grounded theory, with a view of providing a theoretical basis and decision-making reference for promoting the development of vocational education quality. These research contents will also help to make up for the fact that the development characteristics of vocational institutions are not obvious in the field of vocational education research, and the quality evaluation model does not analyze the influencing factors and the relationships among them, which will help to promote the progress of research on vocational education quality evaluation.

3. Research Methodology and Data

3.1. Research Methodology

The grounded theory approach explores and develops theories behind phenomena through systematic data collection and analysis. Glaser and Strauss discovered a strategy for qualitative research in 1967, thus pioneering grounded theory. Strauss and Corbin subsequently refined this approach in 1990 and 1998. Grounded theory is mainly used in exploratory rather than validation research, and the main ideas and assumptions of the method are as follows: (1) The data collected by the researcher are gathered through a process of literature review and interview exchange in a specific research context. (2) The researcher summarizes and subdivides concepts and categories of primary data, and continuously deepens the research topic in comparison. (3) Theoretical sampling is used to achieve theoretical saturation and eventually generate new theories.

This study focuses on the quality evaluation model of vocational education in China, which deals with the specific factors influencing vocational education quality evaluation. There is a current lack of mature theoretical research in this area. Grounded theory has significant advantages in construct theory and is considered to be the most scientific qualitative research method. Therefore, it is feasible to use grounded theory to study the influencing factors and the relationship between factors in the evaluation of the quality of vocational education in China. Figure 1 shows the specific process used in this study. Starting from the basic idea, this study uses grounded theory to organize and analyze the interview materials in depth based on the proposed questions and the literature review; then, through in-depth interviews, open coding, axial coding, and selective coding are conducted in turn; finally, a model for quality evaluation of vocational education in China is constructed using theoretical saturation tests.

3.2. Data Sources

Research based on grounded theory should follow the principle of theoretical sampling. In order to consider the typicality of the sample, this study conducted theoretical sampling based on the following criteria: (1) Interviewees had knowledge and experience in participating in vocational education quality. (2) The interviewees were from different regions and schools, covering different types of schools, majors, and other dimensions. (3) The interviewees were core administrators, teachers, and students at vocational institutions. Therefore, the sample selected for this study is typical.

In-depth interviews with teachers from vocational institutions in Beijing, Tianjin, Hebei, Jiangsu, and Zhejiang provinces of China were conducted between 15 October 2022 and 18 November 2022. These provinces were selected because they reflect the average range of vocational education development levels in China and could provide a sample for the study. Ultimately, this study resulted in 32 interview transcripts covering a total

length of 980 min. After conversion to text, 210,128 words of recorded textual material were obtained. The demographic characteristics of the sample in terms of gender, age, level of education, position, and type of school attended are given in Table 1.
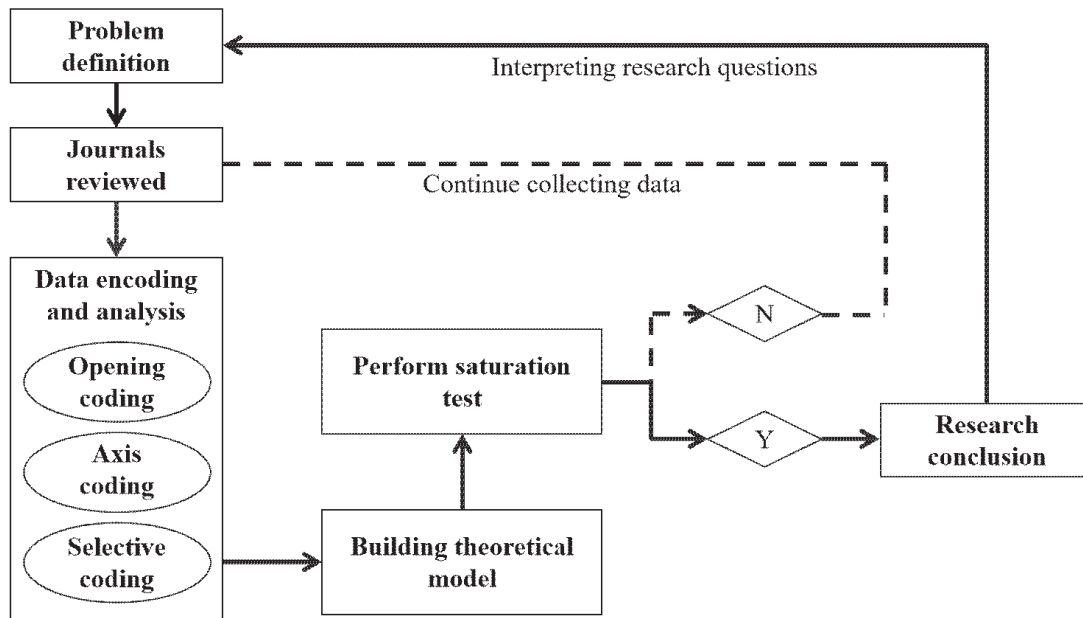

Figure 1. The research path for grounded theory.

Table 1. Demographic characteristics of the sample.

Classification Items	Classification Sub-Items	Number of People	Percentage
Gender	Male	21	65.63%
	Female	11	34.38%
Age	20–29 years old	8	25.00%
	30–39 years old	12	37.50%
	40–49 years old	7	21.88%
	50 years old and above	5	15.63%
Academic qualifications	Doctoral students	7	21.88%
	Master's Degree	20	62.50%
	Undergraduate	3	9.38%
	Specialized and below	2	6.25%
Title	Advanced	5	15.63%
	Intermediate	9	28.13%
	Primary	11	34.38%
	None	7	21.88%
Position	Campus Leadership	6	18.75%
	Middle Management	8	25.00%
	Section level cadres	10	31.25%
	General Faculty	8	25.00%
School Type	"Double-high" schools	23	71.88%
	Non-"double-high" schools	9	28.13%

4. Analysis of Results

Based on the design research method and analysis steps, the in-depth interview materials were coded step by step, with open coding, axial coding, and selective coding. After obtaining the conceptual model, the theoretical saturation was tested and the final theoretical model was generated and interpreted.

4.1. Open Coding

Open coding is a process of initially refining and categorizing concepts from the sample. First, primary sources were selected from the interview material and each statement was labeled. Then, by categorizing and conceptualizing the labels, it was subdivided into the concept "A_{11}". Finally, category "A_1" was obtained by categorizing and abstracting the concepts. The sample was transformed into the same concepts and categories as the original material through conceptualization and categorization to further refine its relationship with the categories. Open coding of the 22 interview materials yielded 44 concepts and 13 categories in Table 2.

Table 2. Open coding and category refinement.

Excerpts from Original Sources	Concept	Category
In fact, the state also has clear requirements for professional development, and for our school, professional development is actually going to be aligned with the "Vocational Higher Education Undergraduate Professional Catalog".	A_{11} Policy Requirements for Majors	A_1 Professional Settings
Take the machinery industry, many of our school majors are built on "industry", for example, intelligent manufacturing engineering technology majors focus on intelligent production process control in the industry. . . .	A_{12} Align with industry needs . . .	
We require students to have manufacturing strength, skills for the nation and Huang Yanpei's idea of vocational education.	A_{21} Professionalism Requirements	A_2 Talent Development Objectives
Schools and enterprises should work together to develop a human accompaniment program, which should also follow the law of growth of technically skilled personnel and highlight the high level of knowledge and skills as much as possible. . . .	A_{22} Policy requirements for talent development . . .	
Our requirements for students are summarized in three points: technical complexity, technical depth, technical innovation, in short, they are still required to master the knowledge and skills in the field of expertise.	A_{31} Course Structure	A_3 Course Construction
I teach no less than 50% of the total professional practice teaching hours. . . .	A_{32} Course Percentage . . .	
Yesterday, we just introduced the method of identifying "dual-teacher" teachers. This means that when building a profession, it is no longer the case that teachers are "transported" in a monolithic way, but that it is better to match them with each other.	A_{41} "Dual-Teacher" Teacher Requirements	A_4 Faculty
For example, the Measures for the Management of Undergraduate Vocational Education Programs mentions the need for an adequate number of "dual-teacher" teachers and teaching teams. . . .	A_{42} Policy Requirements for Faculty Development . . .	

Table 2. *Cont.*

Excerpts from Original Sources	Concept	Category
Public practical training, skills development platform, and innovation and entrepreneurship development platform are also important when building professions, and many schools are building them.	A_{51} Practical training and cultivation platform	A_5 Facility Construction
We need to promote the integration of information technology and teaching, teachers should be skilled in applying some digital and information technology devices, and schools should accelerate the construction of intelligent teaching support environments and build curriculum resources that can meet diverse needs. . . .	A_{52} Building an Intelligent Teaching and Learning Support Environment . . .	
Our school has been carrying out international exchange cooperation for 30 years, and has fully localized and practiced the German dual system, the British modern apprenticeship system, and the Singapore teaching factory.	A_{61} Cooperative Education	A_6 "Bringing in" cooperative education
Our school has a "pilot class" with a German company and is also enrolling international students. . . .	A_{62} Education for International Students . . .	
I once went to Germany for a six-month exchange at the Dual University of Baden-Württemberg.	A_{71} Faculty Communication	A_7 "Go Global" Exchange and Cooperation
Students from our school participated in the BRICS Vocational Skills Competition, which, in terms of international competition standards, focuses more internationally on vocational education students' ability to innovate, coordinate, organize, and cooperate. . .	A_{72} International Competition	
There is an urgent need for us to connect teaching content, assessment, etc. to each other.	A_{81} Multidimensional Instructional Integration Evaluation	A_8 Faculty and Student Evaluation System
Now many schools still pay more attention to the final exam results, I think it is necessary to increase the process of assessment, practical skills assessment results in the total score of the ratio. . .	A_{82} Sound diversified assessment and evaluation system for students	
There is an urgent need for schools to build a professional evaluation system based on professional teaching standards, talent training quality and social services, etc. They can also use technologies such as big data to ensure the quality of the system.	A_{91} Improving the professional evaluation system	A_9 Professional Evaluation System
Schools that are upgraded to vocational undergraduate institutions also need to be evaluated regularly, and the exit mechanism needs to be improved by introducing third-party institutions to evaluate the institutions. . . .	A_{101} Setting up access mechanisms . . .	A10 access and exit mechanism
The recent policy requires that these five years should accumulate more than 20 projects above the department level, and for regional and industry enterprises to carry out scientific research, social services and other projects that can generate significant economic and social benefits.	A_{111} Policy requirements for research and social services	A_{11} Technical Support and Services
Our vocational education is actually a bridge between the two types of institutionalized and non-institutionalized education, providing continuing education and training for people in the community to be able to. . .	A_{112} Services for Lifelong Education for All Universality	

Table 2. *Cont.*

Excerpts from Original Sources	Concept	Category
Skill-based personnel training not only to invest and training, and vocational education personnel in the continuous investment in equipment, facing the problem of many technologies, rapid changes, new equipment and high investment, we are generally and enterprises together to build the integration of industry and education training base.	A_{121} Industry-education integration training base	A_{12} Industry-education integration
Nowadays, vocational education as a type of education should be oriented to serve the needs of industry, to carry out technology accumulation and joint declaration of projects to serve industrial development according to the structural adjustment and upgrading transformation needs of regional industries. . . .	A_{122} Service Industry Development . . .	
At present, enterprises also have a shortage of talent reserves, the development of quality and efficiency needs, school enterprises to build industry colleges is actually a good solution to enable professional industry synergy, through the system to bind the rights and responsibilities of both sides.	A_{131} School-Enterprise Industry College	A_{13} School-Enterprise Cooperation
The courses offered should be organized in order of knowledge depth and difficulty, find the logical relationship between courses, and determine in which semester the courses are more appropriate. . . .	A_{132} Sorting out the logical relationship of offering courses . . .	

The initial concepts were continuously merged, and the 44 initial concepts were divided into 13 categories: professional settings, talent training objectives, curriculum construction, faculty, facility construction, "incoming" cooperative education, "outgoing" exchange and cooperation, faculty and student evaluation system, professional evaluation system, access and withdrawal mechanism, technical support and services, integration of education and industry, and school–enterprise cooperation (Table 3). Only some of the concept codes are shown due to space limitation.

4.2. Axis Coding

Axis coding is the process of classifying and abstracting the categories into major categories by exploring the intrinsic relationships between them. In this study, the 13 categories are classified into 5 categories based on the steps in axial coding, namely, educational orientation, institutional resources, international exchange, organizational collaboration, and evaluation system construction.

At the same time, this study forms a "story line" to describe the relationship between the main categories: educational orientation is the starting and ending point of vocational education quality evaluation; institutional resources are constantly improved according to the development goals of vocational institutions, which is the material guarantee of vocational education quality evaluation; organizational coordination and international exchange are important means of achieving vocational education quality and is the material guarantee for the quality evaluation of vocational education; organizational collaboration and international exchange are important means of achieving the quality vocational education recognized at home and abroad; evaluation system construction is the realistic path and grasp for the development of high-quality vocational education, and is the guarantee measure at the system level.

Table 3. Axis code refinement.

Main Category	Sub-Categories	Scope Content
Z_1 Educational Orientation	A_1 Professional Settings	Compared with comprehensive and research universities, the professional settings of vocational colleges are directly oriented to social production, service, and management fields, concentrating on technical, economic, social service, and information technology fields.
	A_2 Talent Development Objectives	Talent training objectives refer to the specific training requirements based on the national education objectives and the nature and tasks of schools at all levels, which determine the choice of talent training mode, the construction of teaching content and curriculum system, the use of teaching methods, and the matching of experimental and practical training methods.
Z_2 Institutional Resources	A_3 Course Construction	Curriculum construction includes static curriculum system as curriculum plans, curriculum standards and curriculum content, as well as dynamic generation processes such as curriculum setting, curriculum implementation, and curriculum evaluation, etc. The object of curriculum construction in vocational colleges involves three major themes: national curriculum, local curriculum, and school-based curriculum.
	A_4 Faculty	The faculty includes full-time teachers, counselors, scientific research series, and laboratory series personnel in vocational colleges and universities. The faculty referred to in vocational education not only includes personnel with professional and technical positions as teachers but also includes teachers who undertake the task of lecturing courses.
	A_5 Facility Construction	Infrastructure refers to the process of developing and utilizing resources in vocational colleges and universities, including water and power supply, teaching services, research and technical services, landscaping, environmental protection, sanitation and other school public works facilities, teaching support facilities, and public living service facilities.
Z_3 International Exchange	A_6 "Bringing in" cooperative education	The "introduction" of cooperative education refers to the cooperation between international educational institutions and Chinese educational institutions in China to organize educational institutions with Chinese citizens as the main target students.
	A_7 "Go Global" Exchange and Cooperation	The "going out" exchange and cooperation refers to the social responsibility of Chinese vocational institutions through promoting cooperation and exchange, helping education development, funding public welfare, establishing a good image of international vocational education, and promoting the sustainable development of international vocational education to cooperate with other countries to run schools.

Table 3. *Cont.*

| Main Category	Sub-Categories	Scope Content
Z_4 Organizational Collaboration	A_{11} Technical Support and Services	Technical support and service is a form of service provided by vocational colleges and universities for technological innovation, product production, process processing and other processes of industries, trades, enterprises or other social organizations to help extra-educational subjects diagnose and solve their technical problems in the production process.
	A_{12} Industry-education integration	The integration of industry and education refers to vocational colleges and universities actively opening professional industries based on their majors, closely integrating industry and teaching, supporting and promoting each other, and turning schools into industrial business entities integrating talent training, scientific research and scientific and technological services, and forming a schooling model in which schools and enterprises are integrated.
	A_{13} School–Enterprise Cooperation	School–enterprise cooperation is generated by the deep cooperation between vocational colleges and enterprises, with the school based on the development needs of enterprises and tailored for enterprises with targeted specialities. In this cooperation process, the school is involved in the dissemination of theoretical knowledge, while the enterprise has experienced employees to train students.
Z_5 Evaluation System Building	A_8 Faculty and Student Evaluation System	The teacher and student evaluation system refers to the series of value judgment behaviors made on the process and results of classroom teaching, internship, and other activities carried out by teachers and students in vocational colleges, and is a form of system construction to provide feedback on the information.
	A_9 Professional Evaluation System	Professional evaluation system construction refers to the process of investigating, predicting, evaluating, and regulating the quality of vocational education and human resources training when starting a profession, in which specific countermeasures for enhancing the utility of vocational education will be proposed and corresponding programs will be developed.
	A_{10} Access and Exit Mechanisms	Access and exit mechanisms are the conditions that must be met for vocational institutions to carry out the quality evaluation process, and for other organizational actors to enter or exit a market to engage in quality regulation.

4.3. Selective Coding

Selective coding is the process of categorizing and abstracting the main categories into core categories by exploring the intrinsic relationships between the main ones. Table 4 shows the core categories formed by selective coding. Among them, educational orientation is the orientation point of vocational education evaluation, international exchange and organizational synergy are the external factors of vocational education evaluation, and institutional resources and evaluation system construction are the internal elements of vocational education evaluation. These categories are closely related to China's vocational education quality evaluation system and influence the process of China's vocational education quality evaluation undertaking.

Table 4. Selective coding refinement.

Main Category	Core Scope
Education Positioning	Positioning points
International Exchange Organizational Collaboration	External Factors
Institutional Resources Evaluation system building	Internal factors

A model of China's vocational education quality evaluation can be constructed based on the positioning points of China's vocational education quality evaluation and the logical relationship between the three core categories of internal and external factors (Figure 2).
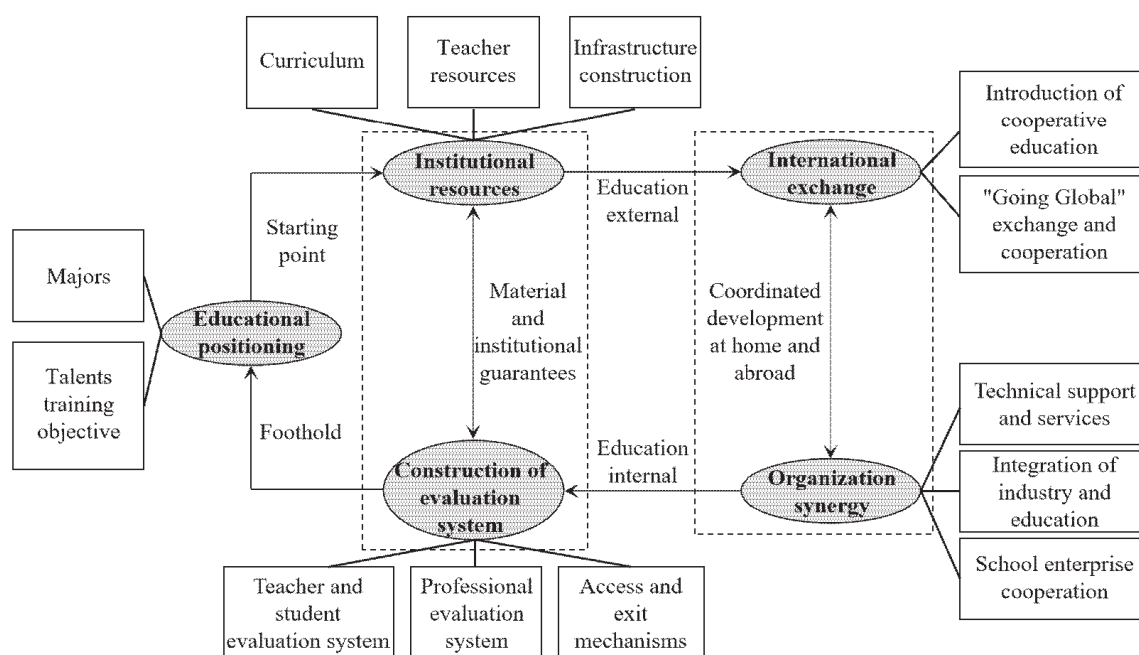
Figure 2. Quality evaluation model of vocational education in China.

4.4. Saturation Test

Using Nvivo 12 software, a theoretical saturation test was performed on the remaining 10 interview materials to determine whether the above theoretical model had reached theoretical saturation. The logic of the theoretical saturation test was repeated for the remaining sample using open coding, axial coding, and selective coding [24]. The analysis did not identify new concepts or categories, nor did it identify new relationships between the categories. In addition, we also gave the coding results and the model to two expert scholars in the field and received positive feedback from them, indicating that the theoretical model shown in Figure 2 passed the theoretical saturation test.

5. Theory and Strategy Explanation

Through the three-level coding process—open coding, axial coding, and selective coding—and the saturation test of the theory, it was verified that the Chinese vocational education quality evaluation model constructed in this study has a theoretical saturation. Based on this model, further elaboration can be made in terms of both theory and strategy.

5.1. Theoretical Explanation

With the development of information technology in the 21st century, globalization has deepened as never before, and there are now more than 250 international regulatory

bodies, more than 2000 international affairs standards, more than 20,000 civil multinational organizations, and 40,000 multinational enterprises worldwide. The deepening of globalization has enabled vocational education to learn and develop new technologies based on enhanced international cooperation and exchange. In such a context, the analysis of China's vocational education quality evaluation model is of epoch-making significance to the development of vocational education in other countries. Theoretical interpretation showed that the positioning of quality evaluation of vocational education in China is educational orientation, external factors are international exchange and organizational collaboration, and internal factors are institutional resources and evaluation system construction, as elaborated below:

(1) Educational orientation is the starting and ending point of vocational education quality evaluation. Contrary to the early days when vocational education was only concerned with the function of connecting to industrial development, the current goal of vocational education development is consistent in the international arena; quality evaluation of vocational education must focus on students' development and be centered on individual quality improvement. The theoretical model of this study points out that the quality evaluation of vocational education in China is directly reflected through the professional setting and talent training objectives, and this view involves the fundamental factors of quality evaluation of vocational education in China. It has been shown that vocationalism and distinctiveness are types of representation of vocational education, and quality evaluation of vocational education based on the vocational competence level is the hierarchical embodiment of vocational education orientation [25]. In order to highlight this type of characteristic, this study constructed a basic theory of vocational education quality evaluation based on the interview materials and set out the main dimensions to be examined in the evaluation of the quality of vocational education in China. On the one hand, professional settings are important objects of quality evaluation of vocational education in China. Since the professional settings are directly oriented to the production, service, and management fields of society, and are concentrated in the technical, economic, social services and information technology fields, they can provide direct assistance to industrial and social development and can better reflect the level of quality of vocational education. On the other hand, the talent training objectives mainly examine the quality factors within vocational institutions that are controllable by vocational institutions and are the dimensions that the leadership, teachers, and students of vocational institutions can focus on. China began to explore a new model of vocational education quality evaluation as early as the mid-1980s to the early 1990s, but there was a certain incompleteness in both the target and the content [26]. This incompleteness was closely linked to the social development and educational environment at that time, and in essence, it showed "pilot action" [27]. This incompleteness in the reform of vocational education quality evaluation also raises a warning for the relevant international research, which is implemented in the specific schooling practice. The global vocational education quality evaluation system is still unsound [28], thus as an important subsystem of the education system, the vocational education quality evaluation system must be focused on the construction.

(2) External influencing factors exist in vocational education quality evaluation. The view that quality evaluation of vocational education in China focuses on factors external to the education system involves external influences on the quality evaluation of vocational education in China and is an important means through which the quality of vocational education can be recognized by the outside world. Many studies have shown that vocational education quality evaluation is a process that encompasses multiple stakeholders [29]. In the 1960s, the academic concept of stakeholders gradually emerged in the West; in 1984, Robert Edward Freeman, an American management scientist, published in *Strategic Management: An Analytical Approach to Stakeholder Management*. In 1984, Robert Edward Freeman formally introduced stakeholder theory

in his book *Strategic Management: An Analytical Approach to Stakeholder Management*, and its influence has been expanding since then. Based on stakeholder theory, this study comprehensively and systematically summarized the external influences on the quality evaluation of vocational education in China from both international and domestic levels. First, in terms of international exchange, the quality of vocational education in China has been improved through two paths: "bringing in" and "going out", mainly through domestic and international cooperation, international student education, professional accreditation, teacher exchange, international competitions, etc. Second, it can also be conducted through the "inbound" and "outbound" paths. Third, the quality of vocational education in China can be improved through organization and collaboration, mainly through technical support and services of vocational colleges, integration of education and industry, and school–enterprise cooperation.

(3) There are internal factors that influence vocational education quality evaluation. There are two educational internal factors influencing the quality evaluation of vocational education in China: institutional resources and evaluation system construction. This view involves two internal means of improving the quality of vocational education in China. The first is achieved by accumulating resources from vocational institutions, and the other is achieved through the construction and strengthening of evaluation systems. In today's international world development change, the purpose of building a vocational education quality evaluation system is not to cope with school assessment or superior tasks, but vocational institutions judge the level of quality of their education and find their strengths and weaknesses in order to improve the quality of their education. The ultimate purpose of vocational education quality evaluation is to improve the quality of talent cultivation, thus its quality evaluation should be of comprehensive quality, including students, teachers, schools, and society, and the improvement of vocational education quality evaluation system is also a comprehensive improvement, including students, teachers, schools and society in many aspects. According to the barrel principle, if any aspect fails to become a short board, the overall quality of vocational education will not meet the requirements. For the accumulation of resources in vocational institutions, vocational institutions can strengthen the specific examination of three aspects, namely curriculum, teachers' teams, and facilities construction, to enhance the quality of vocational education and strengthen the degree of improvement of vocational education quality evaluation [30]. For the construction of an evaluation system, the quality evaluation of vocational education can be improved by improving the teachers and students evaluation system, professional evaluation system, and access and withdrawal mechanism.

5.2. Explanation of Strategies for Vocational Institutions

For many developing countries, the development of education will become unsustainable if they simply keep expanding the scale of vocational education provision and talent training without considering the quality of vocational education. For many countries, the purpose of vocational education is to serve the development of the economy and society and to enhance the competitiveness of industrial transformation and upgrading, however, they neglect the fact that the development of vocational education should be about quality. Quality is a comprehensive term that requires vocational education to focus not only on its economic function but also on the most basic function of talent training. Vocational education cannot be considered to support only economic development without considering its contribution to individuals. To achieve the development of high-quality vocational education internationally, from the perspective of internal factors of vocational institutions, vocational institutions should use professional development, faculty development, curriculum development, and other means to promote the accumulation of internal resources and achieve high-quality operation of vocational institutions. In addition, considering that other organizations at home and abroad have the same influential role in vocational

education, countries should pay attention to the role of external factors when developing vocational education. This study provides insights from the following aspects.

(1) Strictly regulate the setting of majors based on the real needs of industries, which is the first "barrier" to ensuring the quality of vocational education. Scientific and solid research on talent demand is the premise of a professional setting. At present, the literature shows that research on talent demand for vocational education in various countries has shortcomings, including weak scientific evidence, and is necessary for strengthening the guidance and management supervision of diagnosis and improvement. According to the international modern quality management concept, an organization's control and management of the quality of its work involves developing evaluation capabilities to "determine how well it is doing", "find out what is wrong" and "know how to fix it" in time. A quality evaluation system is a tool that provides managers with continuous feedback on how an organization is performing, identifies the potential for success, and identifies problems early enough to ensure timely adjustments. A modern vocational education evaluation system consists of at least three parts: a macro vocational education quality evaluation system that promotes human resource development in the region, industry, or enterprise; a quality evaluation system for vocational institutions; and a teaching quality evaluation system that promotes student development and teacher improvement. There are some differences in the content and specific operation of these evaluation systems, but they have a similar structural framework. Quality evaluation in vocational institutions is aimed at judging the extent to which goals are met after developing new curricula or promoting new management models with the aim of ensuring that the school's work is achieving the desired results.

(2) Promote the development of technical knowledge, the preparation of teaching materials, and teacher training to facilitate the construction of a competency-based curriculum towards depth, which is core to ensuring the quality of education. Internationally, many countries have formed a mechanism that combines internal and external evaluation of vocational education quality. In the UK, for example, internal evaluation of vocational education is conducted by schools on their own, while external evaluation focuses on checking the operational efficiency of schools' internal quality assurance mechanisms. This external evaluation model not only respects the freedom of institutions and academic autonomy but also realizes the perfect combination and complementary advantages of internal and external quality assurance, which jointly improve the quality of vocational education and promote the development of vocational education in the UK. Vocational institutions are the providers of vocational education services, and different groups have different interests and demands and they evaluate the quality of vocational education services differently. The "customers" of vocational education are very complicated, including "client customers", "funded customers", "direct customers", and "commissioned customers". There are many types of customers, including "commissioned customers". The direct customers of education services are students, but they cannot fully choose the services they receive (e.g., schools and courses) on their own and their purchasing decisions are limited; vocational education services are not provided to funders (e.g., the government), but to those who are eligible (e.g., secondary school students who enjoy free education); in the operation of vocational institutions, the evaluation of service quality by customers is often not decisive, and the evaluation by the administration may be more important. In addition, competition among vocational institutions is not market-based; non-market factors such as culture and regional characteristics have an important influence on the choice of vocational education services. All these factors influence the evaluation of the "service quality" of vocational education and the establishment of evaluation systems. Therefore, vocational institutions should use these tasks as their core focus to ensure the supply of high-quality curriculum content

and to promote the formation of knowledge and competence structures for students with specialized skills.

(3) To explore the nurturing function of international exchange and cooperation, industry–education integration and school–enterprise cooperation are key to promoting the improvement in the quality of vocational education. Internationally, many countries will pay attention to the nurturing function of vocational education, and vocational institutions will form vocational education alliance organizations to jointly participate in the process of vocational education talent cultivation to enhance the suitability and quality of vocational education to industry, the economy, and society. Taking the quality evaluation of vocational education in Australia as an example, Australia insists on the principle of quality first, and the practice of extensive participation of industry and employers in quality assessment as third-party evaluators is also becoming more common; this will become an important choice in government management innovation. Australia's higher education quality assurance framework has been highly successful at all levels of government, in individual universities, and for students and other stakeholders. Vocational education is central to Australia's economic growth and business productivity, and the role of third-party evaluation of vocational education in improving the quality of education cannot be underestimated. First, it encourages the active participation of third parties and decentralizes the government; second, it strengthens consultative governance and implements quality control; third, it improves the quality of education and teaching based on students' feedback; and fourth, it supports third-party evaluation through sound legislative organization. Focusing on the quality evaluation of vocational education in China, on 20 April 2022, the Chinese government passed the newly revised "Vocational Education Law of the People's Republic of China", which is a milestone in the development of vocational education in China. Article 43 stipulates that "vocational schools and vocational training institutions shall establish and improve the education quality evaluation system, involve industry organizations and enterprises in the evaluation, and disclose relevant information in a timely manner, and accept education supervision and social supervision", which will play an important role in promoting the establishment and improvement of the quality evaluation system of vocational education in China. The fundamental purpose of the above-mentioned legal provisions is talent cultivation, and vocational education breaks through the bottleneck of education quality, which needs to be oriented to cultivation, to develop adequate domestic and foreign collaborative development goals, processes, evaluation rules, etc., to dig deeper into the cultivation function of the enterprise side of the organization's collaborative process and to promote the acquisition of students' key technical knowledge as well as specialized skills.

6. Conclusions and Future Prospects

6.1. Conclusions

In order to reveal the factors influencing the evaluation of vocational education quality in China, a theoretical model is constructed in this study. This study constructed a theoretical model using grounded theory by conducting in-depth interviews with 53 management, teachers, and students in Chinese vocational colleges and universities, collecting interview data and conducting in-depth research.

The theoretical contributions of this study are: First, this study enriches the fields of vocational education quality evaluation theory and vocational institution development theory. Second, this study constructs the influencing factors of quality evaluation of vocational education in China and discusses the relationship between these factors. These will provide a reference for subsequent studies. Finally, this study extends the application of grounded theory.

In addition, this study has practical value: First, this study opens a research perspective for the government and education authorities to scientifically study the quality of vocational

education, and the relevant authorities will closely follow the perspectives of education positioning, international exchange, organizational collaboration, institutional resources, and evaluation system construction to carry out planning in a categorical and step-by-step manner during policy formulation. Second, this study provides a reference for the evaluation of strategies of vocational education quality adapted to different countries and regions. Finally, this study provides a reference for national vocational education towards the path of high-quality development.

The following three findings were found in this study.

(1) Quality evaluation of vocational education in China is directly reflected through the professional settings and personnel training objectives.
(2) Quality evaluation of vocational education in China focuses on factors external to the education system.
(3) There are two educational internal influences on the quality evaluation of vocational education in China, namely, institutional resources and evaluation system construction.

6.2. Limitations of the Study and Future Prospects

Although the Chinese vocational education quality evaluation model is constructed using the grounded theory approach, there are still some limitations in this study. The theoretical model constructed in this study only represents the current situation of vocational education development in China, and the model has not been tested in vocational colleges or educational institutions in other countries. In addition, the theoretical model constructed from the perspective of qualitative research has not been tested empirically. Therefore, future research should remedy the shortcomings of this study.

Further research could be conducted in the future in the following areas.

(1) Classification and stratification of different vocational institutions in China, validated in secondary vocational schools, higher vocational institutions and vocational undergraduate schools in China, respectively, to observe how the theoretical model proposed in this paper works in practice.
(2) Testing the theoretical model proposed in this paper in other countries or regions.
(3) Exploring the interaction between multiple subjects and factors in the development of vocational education in each country using simulations.
(4) Many countries, including China, Germany, and Japan, are currently developing vocational bachelor's education. Therefore, it is recommended that quality evaluation reform projects be extended to vocational education at the undergraduate level in order to enhance the theoretical guidance of related research.
(5) Since the theoretical model generated so far does not involve a specific index system, it is suggested that AHP or other decision analysis methods be used at a later stage to further explore the specific indexes and index score percentages in vocational education quality evaluation.

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Article

Educational Inequity and Skill Formation Differences Experienced by Floating Rural Students in the Process of Urbanization: A Case Study from a School Perspective

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Abstract: In the process of urbanization in China, the migrant worker population entering cities is an important force in building cities. The children of these migrant workers who do not have the qualifications to participate in college entrance examinations in the city generally become floating rural students. The education problem of the children of the migrant worker population entering the city is still insufficiently considered, and the education inequality and skill formation defects faced by floating rural students are worth paying attention to. This study selected P Middle School in Daxing District of Beijing as a case and took "input–process–output" as the thread to investigate and analyze the school's source of students and enrollment situation, survival strategy and student graduation destination. It tried to present the original ecology of the school's survival situation from the micro level and further interpret the education inequality and skill formation of floating rural students from the perspective of the school's survival. Through the case study, we have found that the academic achievement of students in privately run schools for migrant workers' children is not high. The level of teachers in these schools is low, and teacher turnover is high, resulting in a significant gap in the quality of education compared to public schools. The main source of funding for these schools is donations from members of the community, and government funding is inadequate. Floating rural students in privately run schools for migrant workers' children have poor graduation destinations, with a low percentage of students going on to key high schools, and some students are forced to become returning children, facing institutional barriers to upward mobility through education. These aspects have led to education inequality and possible defects in the skill formation of floating rural students. We hope to clarify and grasp the actual situation of privately run schools for migrant workers' children and put forward corresponding policy recommendations to help bridge the educational inequity in China.

Keywords: disadvantaged groups; floating rural students; educational equity; skill formation

1. Introduction

In recent years, China's private education industry has developed rapidly. By the end of 2020, there were a total of 186,700 private schools (including preschool education) at all levels across the country, accounting for 34.76% of the total number of schools in the country, with 55.6 million students in school, accounting for 19.92% of the total number of students in school in the country [1]. Among them, compulsory education has received widespread attention as a form of public welfare that the state must guarantee. To regulate and promote the development of private compulsory education, the central and local governments' reform exploration has been continuous. On 1 September 2020, the Central Committee for Comprehensive Deepening Reform passed the "Implementation Opinions on Regulating the Development of Private Compulsory Education", which further included private compulsory education in the important policy agenda. According to the "Private

Education Promotion Law of the People's Republic of China" (revised in 2018), private schools are educational institutions held by social organizations or individuals outside of state institutions, using nonstate financial funds, and facing society. Currently, there are three main types of private schools in China. The first type is elite schools, which are private schools that accommodate families and provide international and elite education services with high charges. The second type is characteristic development schools, which have formed distinctive characteristics of operation after a certain period, with moderate charges. Parents' paying for these schools is essentially due to public schools not being able to meet their demand for superior educational resources. The third type is privately run schools for migrant workers' children, which are specifically established to meet the education needs of floating rural students with low charges [2]. In general, floating rural students refer to the population who are under 18 years old and have left their place of residence for more than 6 months with their parents from rural to urban areas [3,4]. In the process of urbanization in China, an increasing number of children of migrant workers have migrated with their parents to seek better educational opportunities in cities. However, due to the limited carrying capacity of urban education centers and the restriction of the expansion period of education, urban areas have set higher enrollment thresholds for public schools for floating rural students, who must choose to enter privately run schools for migrant workers' children. As a special form of education that emerged in the process of urbanization in China [5], the survival situation and related problems of privately run schools for migrant workers' children urgently needs attention and discussion.

According to the National Educational Development Statistics Bulletin, in 2020, 14.3 million students received compulsory education among the migrant population, accounting for 9.2% of the total number of students receiving compulsory education. The acceptance and protection of floating rural students in the place of reception have become a focus of policy discussion. In China, the implementation of compulsory education is based on household registration, meaning that once a child leaves their registered place of residence, their right to compulsory education is also lost. As a result, children of migrant workers become a vulnerable group in the places they move to. In other words, the main reason for sending children of migrant workers to schools for the children of migrant workers is that the government is unable to provide adequate educational opportunities in public schools. Furthermore, the problem of education for children of migrant workers in China is a systematic engineering problem. There are complex interests between the governments of the places they move to, public schools, private schools and the children and families of migrant workers, which weaken the effectiveness of policies to a large extent. In terms of admission and promotion policies, relevant policies such as "mainly managed by the place of reception, mainly by public schools" and "different place entrance examination" have, to a certain extent, guaranteed the legality of floating rural students receiving education in the place of reception. However, the specific policies introduced by local governments have imposed strict restrictive conditions on floating rural students' admission and promotion in the place of reception, such as legal guardian work permits, actual residence certificates, family household registers, temporary residence permits in Beijing, and no-guardian condition certificates issued by relevant departments of the place of household registration. These hard requirements constitute insurmountable institutional barriers for most migrant families. Relevant evidence shows that whether floating rural students can enter public schools often depends on the economic and social resources of their own families. Students whose parents have unstable jobs, low income, and lack of social relationships are more likely to be rejected by public schools [6–8].

In terms of education financial protection policies, in 2015, the "Notice of the State Council on Further Improving the Financial Protection Mechanism for Urban and Rural Compulsory Education" officially announced the cancellation of the central government's award and subsidy policies for urban compulsory education exemption of miscellaneous fees and floating rural students of urban workers receiving compulsory education, replaced by the new "money follows the person" policy. Therefore, the central government assumes

part of the educational expenses of floating rural students of migrant workers on a project-by-project basis, while local governments have a certain amount of room to do their own thing and shirk their responsibilities, resulting in various local models for solving the financial burden of compulsory education for floating rural students of migrant workers. For instance, Shanghai City provides free compulsory education for eligible floating rural students through public schools. Zhejiang Province is based on public schools with private schools as supplements, and Guangdong Province deviates from the central government's principle of "management by destination and public schools as the mainstay" and relies on private schools to provide compulsory education for floating rural students [9]. In the implementation process of policies, although the central government's policy goals are ambitious, the ability and enthusiasm of local government policy implementers may not be as expected [10]. Faced with the influx of a large number of floating rural students, the local government often lacks financial support for public schools, and there is a phenomenon of insufficiency of public school enrollment quotas, and schools charging extra fees to floating rural students or depriving them of the opportunity to receive education are common in many cities [11–13]. In addition, under the Chinese school grading system, top schools are usually elite public schools or expensive private schools, which typically have superior infrastructure, strong faculties and comprehensive curricula and can provide a better environment for floating rural students [14]. However, floating rural students often lack the necessary resources to enter these schools and have to choose lower-grade migrant workers' school [15], which contrasts sharply with their higher educational expectations [16]. As a result, floating rural students become the most vulnerable group to be deprived of the opportunity to study, facing the reality of unequal educational opportunities and unequal education processes.

As a special form of education, privately run schools for migrant workers' children objectively provide education opportunities for children of migrant workers who cannot enter urban public schools. In recent years, privately run schools for migrant workers' children have received more social donations and local government subsidies, and many poorly managed privately run schools for migrant workers' children have been closed or taken over by the government. Therefore, the conditions for running privately run schools for migrant workers' children have improved greatly [17]. However, despite this, the quality of education in most privately run schools for migrant workers' children is poor, and the schools themselves face multiple crises. Specifically, privately run schools for migrant workers' children often lack a stable source of funding and have limited teaching resources [18,19]. The quality of teachers in privately run schools for migrant workers' children is generally low, with low wages, long working hours, and heavy workloads, leading to high teacher turnover [20,21]. Due to a lack of policy supervision and institutional support, privately run schools for migrant workers' children often face the risk of closure and are unable to continuously provide educational resources for floating rural students [22]. As a result, most privately run schools for migrant workers' children are unable to provide a supportive educational environment for floating rural students, which can undermine their academic progress and hinder the development of key skills. Studies have shown that compared to local students and floating rural students who attend public schools, students who attend privately run schools for migrant workers' children perform worse academically [23]. Students in privately run schools for migrant workers' children are more likely to suffer from mental health problems [11,24], lower levels of self-esteem and life satisfaction [25], and experience higher levels of stress, loneliness, depression, and social anxiety [26,27]. In addition, students in privately run schools for migrant workers' children have lower quality employment prospects and face the challenge of class reproduction [28]. On the one hand, most floating rural students who complete junior high school choose to leave the city where they are studying when they enter high school, either to enter the labor market or to attend low-quality vocational schools, because they do not have the qualifications to take the college entrance exam or cannot afford to attend public high schools [29,30]. On the other hand, many students are forced to return

to their hometowns to receive poor-quality education, meaning their chances of attending college are slim, and some students even choose to drop out due to poor adaptation [31]. A recent survey also reveals a more pessimistic conclusion that regardless of the qualifications, educational financial investment and early career aspirations of floating rural students, this group will ultimately be channeled into low-skilled urban service jobs [32].

The well-being of floating rural students is closely related to their educational achievements and China's future social and economic development. Therefore, it is important and urgent to improve the learning and living conditions of floating rural students [33]. However, there are few studies on the educational experiences of floating rural students in privately run schools for migrant workers' children, and the understanding of the actual living conditions of these schools is also limited. To bridge the literature gap, this study takes P Middle School in Daxing District of Beijing as a case study to microscopically investigate the actual living conditions of privately run schools for migrant workers' children and related issues. In terms of research methods, quantitative studies are limited in their examination of meaning and the complexity of action interpretation. The case study is best suited to instances in which: the type of question is the 'how' and 'why', the object of study is a current event, and the researcher has little or no control over the current event. Therefore, this study adopts a case study approach, attempting to use the "input–process–output" as the guiding principle to analyze the source of students and enrollment situation, survival strategy, teaching quality and student graduation destination of P Middle School. It presents the original ecology of the school's living conditions from a micro perspective, grasps the actual situation of the development of privately run schools for migrant workers' children, and further interprets the educational inequality and skill formation difference of floating rural students from the perspective of the school's way of survival to help bridge the phenomenon of educational inequity in China.

2. Research Strategy

2.1. Selection of Research Cases

This study selected P Middle School as a case study for two reasons. First, the appropriateness of the school's nature. P Middle School was established in the spring of 2005 and is located in Daxing District, Beijing. The school building has an area of nearly 4000 square meters. P Middle School is a privately run school for migrant workers' children, with a public welfare and nonprofit private middle school positioning, adhering to the principle of "returning the right to receive a qualified education to the children of migrant workers." Since its official establishment in 2005, the school has received attention and support from various sectors of society. Under the policy background of the Beijing Municipal Government's active response to the central leadership and the issuance of the "Opinions on Encouraging Social Forces to Promote the Healthy Development of Private Education," the survey of P Middle School has important practical significance and necessity. Second, exploration space and research value. In March 2014, the central government issued the "National New Urbanization Plan (2014–2020)", which required that "the population size of large cities with more than 5 million people in urban areas should be strictly controlled". In accordance with this, the Beijing Municipal Government has adopted multiple measures to control the population, such as "controlling people by industry" and "controlling people by housing". Since the implementation of the policy, several "incompetent" or unqualified privately run schools for migrant workers' children have been shut down in Beijing. However, P Middle School has survived to this day due to its strong spirit of education and unique action strategies. Therefore, this research attempts to decode privately run migrant workers' schools' way of survival through a case study.

2.2. Data Collection and Analysis

This study mainly uses interviews and observations to collect data. Before the survey, the researcher carefully reviewed relevant policy documents and literature on the operation of floating rural students' schools and developed an interview outline (as shown

in Appendix A). At the same time, based on the school's official website, WeChat public platform and other media platforms, key information is collected to facilitate timely and effective follow-up interviews. This study uses the principle of purposive sampling and selects one school leader, one teacher representative, and two middle school students from P Middle School as interviewees. At the same time, we also visited the teaching facilities, teacher's offices, library, and other places at the case school, obtaining fresh materials and extracting valuable information from them. After obtaining the consent of the interviewees, we recorded the interview dialog and promptly organized and analyzed the interview data.

3. Case Presentation and Analysis

This study uses the "input–process–output" model as a context clue and analyzes the source of students and enrollment situation, survival strategies, teaching quality, and students' graduation direction in P Middle School. It presents the original ecology of the school's living environment from the micro level and interprets the educational inequality and skill formation differences of floating rural students from the perspective of the school.

3.1. Input: Source of Students and Enrollment at P Middle School

The intended enrollment for P Middle School is non-Beijing and Beijing residents who have graduated from elementary school; however, the actual enrollment is almost entirely non-Beijing residents. The top three provinces in terms of student population are Henan (37.47%), Hebei (15.75%), and Shandong (13.60%). Currently, P Middle School has 15 classes with a total of 419 students enrolled. Of these, only one student is a Beijing resident, who is the child of a faculty member, while the rest are non-Beijing residents. According to P Middle School's annual report, nearly 90% of students come from rural households, and over 80% of their parents have been working in Beijing for over 8 years.

The P Middle School has an enrollment quota of approximately 200 students per year. In the early days of the school's establishment, the school prioritized and admitted students from the poorest families among those who met the basic admission requirements, providing limited enrollment opportunities to the most disadvantaged students.

> "Our school's children are all workers' children, so their families are relatively poor. More than half of the families are poor, and approximately one-third of the families need support in terms of school fees. In terms of parenting methods, guidance, and accompanying children, most children may be lacking." (Teachers)

> "The students we enroll are not very good at their level. Although some children learned English in primary school, when they are in junior high school, they are not very good at writing 26 letters." (Teachers)

P Middle School has recently seen a shift in its enrollment trend from "demand exceeding supply" to "supply exceeding demand," with the number of applicants remaining stable at approximately 170 to 180 per year. P Middle School student attrition is primarily influenced by the Beijing government's policies, as one teacher mentioned in an interview:

> "In recent years, Beijing has begun to concentrate on cleaning up illegal houses, and the number of people renting in Daxing District has decreased. Some families may have left Beijing to go to Hebei. This has actually had a very significant impact on the changes in enrollment numbers in recent years." (Teachers)

This shows that P Middle School's students are in a naturally disadvantaged position, which is not conducive to educational equality. On the one hand, these students are forced to enter the school for migrant workers' children due to restrictions on the admission policy of public schools or economic resource constraints. They usually come from families with poor economic backgrounds, have poor academic foundations, and lack parental support and emotional support. On the other hand, under the influence of Beijing's population dispersion policy, some students have no choice but to become returning children, following their parents out of Beijing to their hometown. They are deprived of the opportunity to

enjoy urban educational resources and face the risk of poor adaptation upon returning to their hometown.

3.2. "Destiny and Pursuit": P Middle School's Survival Strategies

To gain a deeper understanding of the survival situation and strategies of the case study school, we use the dynamic ability framework proposed by Teece et al., including Processes, Positions, and Paths [34], to examine and analyze the survival strategy of P Middle School (as shown in Figure 1). Specifically, we focus on learning mechanisms, capability systems, dynamic mechanisms, and strategic paths.
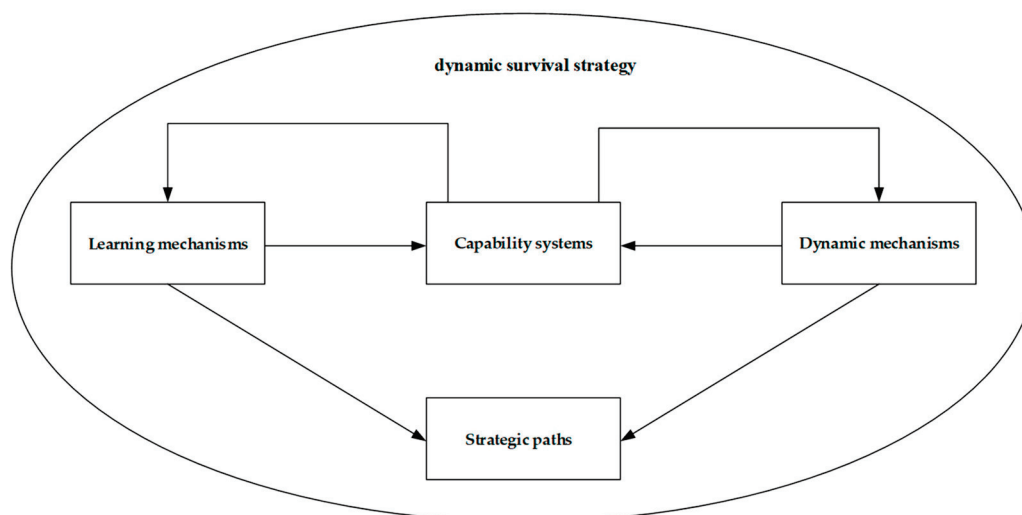
Figure 1. Analytical framework of the school's dynamic survival strategy.

3.2.1. Learning Mechanisms

Private schools in the compulsory education stage may independently carry out education and teaching activities on the premise of completing the curriculum prescribed by the state. In the face of changes and development of the internal and external environment, it is particularly important to form a continuous learning mechanism and make corresponding adjustments to the school's educational philosophy, curriculum, and teaching methods. With the goal of "returning the right to receive qualified education to the children of migrant workers, and ultimately realizing the integration of educational equity and high-quality education", P Middle School implements the autonomy of school operation within a reasonable scope through a series of "combined punches", such as the implementation of the "layered teaching" model and the establishment of a characteristic curriculum system. The survey found that P Middle School encountered difficulties in carrying out the abovementioned curriculum teaching actions. First, the energy of P Middle School teachers is finite, and their basic teaching work consumes more time and emotions. Especially for teachers who have assumed certain management positions, they also need to deal with daily class management and busy administrative work. Second, teachers lack the knowledge and ability to carry out characteristic courses and interest groups, and most teachers in the school lack teaching experience and professionalism that meet the corresponding teaching standards, except for some teachers who were originally interested in and mastered the relevant course content. Third, P Middle School has a limited budget and cannot afford to invest heavily in inviting teachers from outside the school to open classes. In this regard, P Middle School harnesses the power of volunteers. The interviews found that volunteers came to the school from all over the world with a genuine attitude, including senior teachers to provide course guidance and university student clubs or international students to provide services based on their expertise. In summary, the volunteer community is an integral part of the P Middle School education system.

"I think that is what makes P Middle School so attractive and special. In other words, when we want to volunteer, we will first consider whether the recipient group truly needs help. Therefore, when volunteers choose, they will consider coming to us. There is also a caring community from University A that has established a connection with us for many years, which is a good continuation. Such organizations are rare, and perseverance is invaluable to everyone. Therefore, we welcome such clubs and schools." (Teachers)

In short, P Middle School currently provides low-cost, low-quality education. Existing learning mechanisms can lead to poor skill formation and lower skill formation than in ordinary schools. On the one hand, teachers in privately run schools for migrant workers' children do not have long teaching experience, the quality of teachers cannot be compared with public schools, and the construction of characteristic courses and interest group activities in schools is also constrained. On the other hand, although P Middle School uses volunteer power to provide supplementary teaching services, most of these volunteers are college students who are highly mobile, and the quality of teaching is uneven; therefore, they cannot provide students' skills formation and development stable learning guarantees.

3.2.2. Capability Systems

P Middle School adheres to the talent concept of "teachers are priceless", and the training of teachers is the top priority of the school's human resources construction. The school has 79 teaching staff, with an average teaching age of 6.1 years, mainly young and middle-aged teachers who are non-Beijing residents with college degrees. Among them, many young people have just graduated and entered society to seek employment. Not only do they lack teaching experience, but they also have to deal with three major challenges: a very weak student base, a tough school environment, and high standards of work but low pay. In the early days of its establishment, the staff turnover rate of P Middle School was as high as 59%. However, over time, the teacher turnover rate has decreased significantly each year and has shown a relatively stable development trend since 2010.

P Middle School implements a principal's responsibility system under the guidance of the Council, which is composed of volunteers who have achieved certain achievements in various fields, pay attention to education and are passionate about giving back to the community. Major issues related to teaching staff are generally decided jointly by the standing council of the school and the teachers' union. At the beginning of the establishment of the school, China International Finance Corporation set up the "Special Fund for Teacher Professional Growth" in the school, which has not been interrupted to this day, and has largely supported the school to always take the growth of the teaching team as a top priority and reduce the teacher turnover rate as much as possible. Each semester, the school sets the semester theme according to the mental and ability development of the teaching staff to overcome the weaknesses and deficiencies at the teacher level with collective strength to ultimately help improve the quality of school education and teaching and talent training. The school also provides corresponding training opportunities and training platforms for teachers at different stages of professional development. However, middle school teachers may not have an advantage over the treatment and professional development of public school teachers. In contrast, compared with material incentives, the school provides more spiritual support for teachers and thus attracts a group of teachers who truly recognize the original intention, educational philosophy, and school culture of P Middle School. However, it needs to be recognized that there are still certain differences between private school teachers and public school teachers in terms of professional training, job appointment, calculation of teaching and working years, and commendations and awards.

"We also go to some continuing education schools, but we still do not learn in the same way as public education. Public education actually has a system to accumulate credits. However, we're just trying to learn. In fact, to be precise, we are not fully integrated into their system by the state." (Teachers)

"We are in a special industry. We are in a nonprofit organization. The most important thing is that teachers should recognize our school philosophy, be patient and invest energy in education, and be willing to take care of and educate these floating rural students. However, in fact, we are also in the process of finding resources and possibilities. Because teachers have to teach children well, they must also continue to learn." (Teachers)

Teachers are key to ensuring the quality of education. According to the interviews, although P Middle School has adopted a series of measures to help teachers grow by providing training opportunities and moral support, the problem of teacher turnover in P Middle School should not be underestimated. The interviews found that teachers in private migrant schools not only find it difficult to obtain salaries comparable to those of enterprise employees or public school teachers, but also have to put in more effort and bear great professional pressure due to problems such as poor student quality. These factors greatly reduce the attractiveness of the position for teachers. As a result, the instability of the teaching workforce further exacerbates the educational inequalities faced by floating rural students. On the one hand, teacher mobility disrupts the original teaching arrangements and poses challenges to students' continuous learning and curriculum management. On the other hand, new teachers often have limited knowledge of students' academic background, and it is difficult to establish close and stable relationships among teachers, students, and parents, which has a negative impact on students' ability development for a long time.

3.2.3. Dynamic Mechanisms

The Beijing Municipal People's Government's Implementation Opinion on Encouraging Social Forces to Promote the Healthy Development of Private Education (hereinafter referred to as the 'Implementation Opinion') clearly states that social organizations or individuals are encouraged to engage in private education in the form of donations, investment, cooperation, and other forms. At the same time, social forces are encouraged to donate to nonprofit private schools and guide nonprofit private schools to use donated funds and school management surpluses to apply for the establishment of education foundations (funds) to provide financial support for the development of the school, teachers and students. In P Middle School, social donations are the main source of income for the school's operation and maintenance. The research found that P Middle School's total annual income was 10.29 million yuan, of which the social donation income was 8.19 million yuan, accounting for 79.60% of total income; domestic individual donations are the main source of social donation income for P Middle School. Overall, the main way for P Middle School to obtain donations is through the promotion of foundations and spontaneous donations by social figures, and the structure of donors is essentially stable, with individual donations as the mainstay, but the sources are relatively scattered and the amounts are relatively unstable.

In addition, how is the financial support provided by the government? The Implementation Opinion states that city- and district-level finances should arrange funds to support the development of private education and incorporate them into the annual budget to establish and improve a system of government subsidies, clearly defining the subsidy items, objects, standards, and uses. The research found that P Middle School received government subsidies of 907,700 CNY in a year, accounting for 8.82% of the year's total income, which was relatively small compared to the income from social donations. At present, the government subsidy items for P Middle School mainly include the average quota subsidy of 875 CNY/person/semester for public funds in the compulsory education stage, the free textbook subsidy of 49,223.19 CNY, and some subsidies for basic facilities (such as school electric gate repairs, laboratory construction, projector equipment, etc.). In the interviews, some teachers responded to the issue of government financial support. Overall, for P Middle School, a privately run middle school for workers' children, social forces fulfill the government's responsibilities to a certain extent.

"For example, we now have approximately 600,000 yuan a year for heating, and it is actually very difficult to find someone to raise funds. However, for public education,

this is a small move in financial allocation. Private education is all self-help with expenses like heating and electricity. Therefore, the pressure on school is truly high." (A school Leader)

"I think government support is certainly better. Just now we were talking about the chalk in the classroom running out. We might be better off if we did not need to go outside to find resources ourselves. However, we also do not require the government to do everything in one step, which is impossible, and we also want to rely on the help of social forces. Our school is actually picking up the gaps and catching up the education of those children who still have many needs and are not fully covered by the policy. Of course, I also hope to work with the government to do a good job in education." (A school Leader)

From the above interviews, P Middle School faces challenges in school fundraising, and the lack of government funds is one of the factors leading to poor teaching quality and student training. On the one hand, although government departments provide financial subsidies to privately run schools for migrant workers' children, there is still a huge gap in funds for these schools. On the other hand, although privately run schools for migrant workers' children have received strong support from caring people in society, these funds are mostly individual donations, and the sources are scattered. Therefore, the conditions for running privately run schools for migrant workers' children still have room for improvement. Due to the lack of necessary government funding support, schools are unable to provide sufficient and high-quality teaching resources, and the school's infrastructure and even curriculum construction are significantly different from those of public schools, which may not be conducive to students' skill development.

3.2.4. Strategic Paths

The so-called strategic path, for P Middle School, is more of a beautiful vision for education, that is, an appeal and prospect on a normative level. Despite facing numerous obstacles and practical pressures, P Middle School, because of its clear educational positioning and sincere educational philosophy, has a strong irreplaceability. This was also confirmed to some extent in the interviews with the school leader.

"Only those who truly approach the school will realize this problem: what should the child do after elementary school, he does not want to go back and become a left-behind child. Therefore, people in society who care about children's healthy growth are like this, hoping that there are schools like us to provide children with an opportunity to participate in quality education, so that these children can still have the opportunity to stay with their parents." (A school Leader)

The achievement of any strategy is largely inseparable from the enrichment of material support and resource supply. With limited government support, "living in the present" is the most prominent survival strategy for P Middle School. P Middle School actively plays the role of a social force to gather effects, link and attract various social subjects, and benefits the development of the school and talent training. Because the school's operating funds are mainly composed of tuition fees, government support, personal and group donations, and social donations are the main source of school income. Therefore, the school uses these valuable assets in accordance with the principles of high responsibility, professionalism, and transparency. In the early days of the school, the school's finances were personally accounted for by volunteers from KPMG, and the training of accountants gradually transitioned to supervision. Since its establishment, the school has always regarded good financial management as the lifeline of survival and development and carefully uses hard-won social assets.

Good strategic planning is the key to better training students in privately run schools for migrant workers' children. P Middle School faced a shortage of school funds and wisely chose to play a role in the development strategy of social forces funding. It is because of the community's support and the school's focus on managing its finances that privately

run schools for migrant workers' children are able to ensure basic schooling conditions and provide basic educational opportunities for floating rural students.

3.3. Output: Where to Go after Graduation?

Where do the students of workers' children schools graduate from junior high school? Data show that the passing rate of P Middle School's 2019 graduates in the middle school exam is 93.8%, and 85.7% of the total number of graduates enter ordinary high schools, while 14.3% of the total number of graduates enter vocational high schools. However, in 2019, the gross enrollment rate of higher education in China was 89.5%, close to 90%. Longitudinally, after three years of in-school study, P Middle School's graduates have indeed achieved some academic achievements, and a certain proportion of students have been able to enter the next stage of study. However, horizontally, the proportion of P middle school junior high school graduates entering regular high schools still has a high potential for improvement.

> *"The proportion of students going to key high schools is not very high. They can go to other provinces to find high schools or vocational schools based on their Beijing high school examination results. Although Hebei Province enrolls students from Beijing to participate in the high school examination, Hebei Province still prioritizes enrolling its own students; unless it has the capacity to enroll more students, it can then recruit students from Beijing. Therefore, in fact, there are actually only one or two key high schools in Hebei province that our students can go to, and they are relatively few. Most good high schools actually do not admit them."* (A school Leader)

According to the interviews, P Middle school students generally go to poor destinations after graduation, and the proportion of students going to key high schools is not high, which is one of the factors that leads to educational inequality. On the one hand, although most students can take exams in Beijing, due to the fierce competition for admission to high schools in their hometowns, students have a hard time attending their favorite high schools and can only go to low-quality vocational schools; on the other hand, some floating rural students are forced to become "returning children" under the influence of the population redistribution policy, facing poor adaptation after returning home. These findings largely echo previous research [28]; that is, the education achievements of students in privately run schools for migrant workers' children are low after junior high school, and the type of education they receive after junior high school is low. The reasons for the failure of these groups' "high school dream" and "university dream" include, but are not limited to, family economic reasons, information reasons, lack of self-interest and motivation, education quality, etc. However, a large amount of evidence shows that the real cause of the shattered educational dreams of groups such as urban migrant workers' children is the series of institutional barriers centered on the household registration system. As previously mentioned, the current education system and college entrance exam system are based on household registration, resulting in the difficulties of migrant children in making decisions at the end of junior high school. Most of the students at P Middle School are non-local residents in Beijing, and the quality of education they receive at school is not high, which leads to their low competitiveness in selective exams; thus, they are unable to enter higher level schools in Beijing after graduating from junior high school.

4. Discussion

4.1. "Good Intentions" but "Insufficient Strength": Who Will Pay for the Educational Dream of Floating Rural Students?

The mission and values of the case school, P Middle School, have always been to "unite equity and quality education", and it is also a direction that the teachers of the school recognize and strive for, attracting donations and volunteering from the community. However, in terms of hardware facilities, teaching difficulty, curriculum positioning, and faculty composition, the school's actual practices reflect only "passable education." The biggest challenge for the school at present is having "good intentions" but "insufficient

strength." This is not only the reality of P Middle School as a case study but also the current situation of many other privately run schools for migrant workers' children sharing the same fate and of those privately run schools for migrant workers' children that have already been shut down.

The "Compulsory Education Law of the People's Republic of China" clearly stipulates that compulsory education is the education that all eligible children and teenagers must receive and is a form of public welfare undertaking that the state must safeguard. Although the financial policy of compulsory education for children migrating to cities has always been aimed at education equity and the government's delineation of funding structures and areas of responsibility has gradually become scientific and refined, there is a risk that the policy effect will be weak in the process of policy implementation to a greater or lesser extent. If adequate financial support is not provided to students in privately run schools for migrant workers' children, the government will not fulfill its obligation under the "Compulsory Education Law" to provide equal access to compulsory education for children of migrant workers. Therefore, who should bear the cost for the education dream of this group, and how should it be done? These issues are worth considering and exploring.

4.2. "Reconcilable Tension": A Conflict between Market Preferences and Quality Preferences

In contrast to public schools, private schools tend to regulate their schooling behavior based on the market, that is, through means of flexibility such as charging fees, social donations, curriculum and teacher settings, to adjust survival strategies to operate effectively and develop in the long run. Relevant research has found that many domestic privately run schools for children of migrant workers have tailored humanized services in terms of student accommodation and academic counseling. For instance, through flexible enrollment, tuition installments, and frequent home–school communication (such as after-school supervision and home visits), schools meet the educational needs of disadvantaged groups to some extent [35]. A similar finding was observed in this study based on a case study of P Middle School. It can be seen that privately run schools for migrant workers' children have largely responded to the educational needs of disadvantaged families and are in line with the economic ability of these families and the market preference for accepting compulsory education. At the same time, along with the increasing popularity of higher education, an increasing number of families expect their children to have access to higher education and expect their children to be able to take a place in the first level of the labor market and achieve class mobility due to the sheepskin effect [16]. In China, the traditional idea of "knowledge changing fate" and "study hard and make a good career" is deeply rooted in the hearts of many parents, especially in some rural marginal areas. Parents have a stronger psychological and behavioral tendency to hope that their children can receive a good education to improve their family's future economic situation. Even though the possibility of obtaining high-quality education is slim in the eyes of most disadvantaged families, it does not affect their view of it as a "stepping stone" to change their fate. The pursuit of high-quality education has given rise to these families' preference for quality, and as a result, the relationship between market preference and quality preference has become more tense.

4.3. "Not Acclimatized" and "Habits of Division": "Returning Children" in a Tight Institutional Space

Under the influence of the household registration system and "population control" policies, the migrant population engaged in labor-intensive industries has become the main group of evacuated people, which has forced some floating rural students to follow their parents, who are homeless in the city, to return to their place of household registration. This group is usually referred to as returning children who have lost the opportunity to receive relatively high-quality education and further study in the city and face systemic barriers to upward social mobility through education [22,36]. More importantly, after floating rural

students return to their hometown, how to effectively adapt to local education and life has become an urgent practical issue. It is not difficult to imagine that returning children not only feel physiologically unacclimatized due to changes in their living environment but also suffer from huge psychological gaps and alienation due to the habits of division between urban and rural areas. Returning children face difficulties in academic continuity, interpersonal communication, and social adaptation, and their physical and mental health and individual development needs are urgently in need of attention.

5. Policy Implications

5.1. Ensure the Public Welfare of Compulsory Education in Accordance with the Law and Pay Equal Attention to Financial Support and Accountability

Adhere to the government's legal responsibility to develop compulsory education, in accordance with the law to guarantee the public welfare of compulsory education, and reasonably coordinate the development of public and private compulsory education. The first is to strengthen financial support for privately run schools for migrant workers' children and improve the quality of school management. In the meantime, we must effectively implement the "Private Education Promotion Law", clarify the status of floating rural students' schools and improve the quality of school management through various strategies. Among them, the focus is on financial support, with increased support in terms of average public funding for students and improved school conditions. The second is to implement support and accountability. All private compulsory education schools should be included in the daily supervision of the supervisory responsibility area, and places that do not fulfill the government's responsibility for the development of compulsory education should be seriously accountable in accordance with relevant regulations. This also greatly enhances the awareness and initiative of private schools to accept external accountability and achieve a win–win situation. The third is to further implement and improve policies for floating rural students to participate in the college entrance examination in the place of flow and improve the fair access mechanism for college entrance examination opportunities.

5.2. Effectively Strengthen the Construction of Teachers and the Attractiveness of Teacher Positions in Schools for Floating Rural Students

The "Private Education Promotion Law" clearly stipulates that teachers in private schools have the same legal status as teachers in public schools. However, in terms of specific policies and practices, there are still differences in the status and policy treatment enjoyed by public and private school teachers. The 2018 "Opinions of the Central Committee of the Communist Party of China and the State Council on Comprehensive Deepening the Reform of the Construction of Teachers in the New Era" reaffirmed that private school teachers are legally protected and hold the same rights as public school teachers in terms of professional training, appointment of duties, calculation of teaching and working years, commendation and rewards, scientific research projects, and other aspects. Therefore, the first is step to strengthen the professional development of private school teachers. Particular attention should be given to the professional development of floating rural students' school teachers. Previous experience has shown that there are differences in the professional preparation and impact on student performance among teachers of different types, and that the professional development of teachers in China requires a more precise system of subject-specific training support [37]. If the level of floating rural students' school teachers does not reach the required and basic level of professional development, it is unfair to floating rural students. On the one hand, we must strengthen the regulation and management of private schools to protect the legitimate rights and interests of teachers, and on the other hand, we must increase financial support and supervision to ensure that private school teachers and public school teachers have equal training opportunities and learning resources. The second is to speed up the reform of the social insurance system, accelerate the integration of pension insurance for institutions and enterprise employees, and solve the problem of different treatment standards for public and private school teachers after retirement.

5.3. Coordinate Social Forces to Help Improve the Quality of Talent Training in Schools for Floating Rural Students

For the case school, P Middle School should continue to uphold the original intention of running the school and consolidate its own irreplaceability and school attractiveness with its sincere emotions and practical actions. In terms of the overall development of floating rural students' schools, it is necessary to encourage more individuals and social groups with aspirations for education to provide certain donations to floating rural students' schools based on their own ability categories. College students at home and abroad should be encouraged to participate in volunteer service activities if they have spare time, play their professional strengths, and use their professional expertise to help build the school's special curriculum and campus culture. Schools should also actively establish a long-term mechanism for home-school cooperation, enhance the sense of belonging of floating rural students and keep parents informed of the progress and growth of their children in a timely manner.

5.4. Pay Attention to the Physical and Mental Health and Education of Returning Children

In the long term, the fundamental cause of the plight of returning children is the disparity in development levels and the unequal allocation of education resources between urban and rural areas. Therefore, the government needs to further promote the optimization of education resource allocation in rural areas and support the construction of rural schools to improve the quality and attractiveness of rural schools. Urban areas also need to accelerate the reform of the household registration and school enrollment system and create more policy space for public services and social security for migrant workers and their children under the goal of urban population dispersion.

In the short term, the reform of the household registration system and the education system will not happen overnight, and the phenomenon of children returning will continue under the competitive situation of tight educational resources in large cities. Therefore, it is crucial to help children who have already or are about to "flow and left behind" to better integrate and adapt. First, the government needs to assist rural schools in receiving returning children. Schools not only need to help returning children adapt to the difference in teaching content through learning diagnosis, after-school tutoring, and textbook integration but also need to actively popularize "local knowledge" to returning children through school-based courses or daily cultural activities, helping them overcome obstacles such as dialect and customs. Second, teachers need to provide feedback on the psychological and interpersonal states of returning children through timely communication. Additionally, parents need to make more rational decisions on the issue of their children moving to the city and returning to the countryside. Parents who have the conditions can arrange for their children to return to schools in county towns around the working cities and seek the help of guardianship organizations, providing children with more "nearby" education support and growth care.

6. Limitations

The limitations of this research's method are as follows. First, this research only selected one privately run school for migrant workers' children in Beijing as the case study, and the findings cannot represent the general situation of privately run schools for migrant workers' children in China but only illustrate the current problems of educational inequality and skill formation among floating rural students. Future research needs to be conducted on a larger scale of privately run schools for migrant workers' children to reveal general conclusions. Second, case studies cannot provide causal conclusions. Future research needs to adopt more scientific quantitative survey methods to explore the impact of privately run schools for migrant workers' children on the skill formation of floating rural students and to further compare the effectiveness of public and private schools as well as the differences in skill formation among floating rural students. Additionally, we will further use the data to verify the relevant conclusions in the future.

7. Conclusions

First, the academic achievement of the enrolling students at privately run schools for migrant workers' children is not high. Most of these students are floating rural students from rural households and poor families. They have weak academic backgrounds and a lack of parental guidance and companionship.

Second, the learning mechanism of privately run schools for migrant workers' children is not good. The school's teacher level is not high, the teacher turnover rate is high, and the quality of characteristic courses is significantly lower than that of public schools.

Third, the main source of funds for privately run schools for migrant workers' children is donations from social workers, which are dispersed and unstable, and the government's investment in privately run schools for migrant workers' children is insufficient.

Fourth, floating rural students in privately run schools for migrant workers' children have poor graduation destinations, with a low percentage of students going on to key high schools, while some students are forced to become returning children, facing institutional barriers to upward mobility through education.

These aspects have led to education inequality and possible defects in the skill formation of floating rural students.

Appendix A

Interview outline
For school leaders

1. From the annual reports before 2016, we have learned about the basic information of the school, the sources of students and their situation after graduation, the composition of teachers, and some special activities held by the school. I would like to ask, in recent years, what are the major changes in these four aspects?
2. Basic information (new school building's rising costs, government subsidies)
3. Where does your school recruit from? What are the criteria for admission? Do you know the further development of students after graduation? How many of the 80% of students who went on to general high school received higher education?
4. As students generally come from migrant families, what specific measures have schools taken to establish a good home-school relationship and participate in students' education?
5. The principal once said that the school has accumulated a few good teachers in the development process; so, I want to ask how you recruited and attracted these teachers. We know that the total number of teachers has not changed very much over the years, how is their turnover and how do you motivate teachers to stay in the school for a long time? (Teachers' salary structure, bonus performance, vocational training, etc.)

6. How much subsidies do the government give to school each year, and has it always been so much? What are they probably used for?
7. At present, we can only see the school's information in 2016 from the internet and find that the school's funding comes more from donations. You have also mentioned that the demand for funds is relatively large for a new building; so, I want to ask whether the structure of funding has changed in recent years. Can you introduce the source of funding (structural stability)? Affected by the epidemic, will there be a certain gap between this year's donation and previous years? (Additionally, can you provide annual reports after 2016?)

For teachers

1. Where are you from? How long have you been teaching at P Middle School? Why did you choose to be a teacher at P Middle School?
2. In addition to the main teaching content, what special courses did you participate in? (Including life education, subject inquiry, differentiated instruction, and school-based curriculum, etc.) Can you introduce them in detail? How did you prepare? How about the effect and students' feedback?
3. We know that the school will provide teachers with the opportunity to participate in high-quality training. How does the school arrange teacher training, teacher research, and professional title evaluation during tenure? Are there differences among teachers at different stages of their professional development in these aspects, and what efforts have you made?
4. We notice that there are many volunteers in the school, and some volunteers participate in fixed courses. Why do volunteers need to be involved in long-term teaching?
5. Are there many students in your class receiving financial aid? How much is the subsidy? What is the standard of subsidy?

For students

1. Where are you from? How long have you been in Beijing? Where did you go to elementary school? How did you get into P Middle School?
2. What do you like most about school? For example, what are you satisfied with and what are you not satisfied with (the overall environment, the curriculum, and the relationship with teachers and students)?
3. What has been your biggest change since you came to P Middle School?
4. You usually have some extracurricular activities, such as interest groups, classroom extensions, and summer (winter) camps. What extracurricular activities have you participated in, what is the most impressive activity, and are there any additional gains to share? Will it affect your usual learning? (What do you do after dinner?) (What is the meaning of short-term volunteering for students?)
5. Have you received a scholarship? (If so, when is it usually sent?) What kinds of students are generally awarded scholarships?
6. Do you usually contact your parents as you board at school? Do parents know your performance in school? How long have your parents been in Beijing? What kind of work do they do?

For volunteers

1. Why did you choose to volunteer at P Middle School?
2. Can you comment on P Middle School? Did you have any special feelings during your volunteer service?

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Article

A Contagious … Smile! Training Emotional Skills of Adults with Intellectual Disability in the Time of COVID-19

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Abstract: The COVID-19 emergency has had important implications not only for physical but also for psychological well-being. This is particularly true for fragile populations such as people with intellectual disability (ID), who are particularly at risk of suffering during uncertain times. The goal of this action research was to design, implement, and test the efficacy of emotional competencies training to support people with ID in coping with stressful events. For this purpose, eight adults with ID followed a 5-week training of increasing complexity, aimed at exercising different skills through group activities. We designed a study to test its feasibility and efficacy, using both quantitative and qualitative methods. The analyses revealed that, after the training, participants used a more complex emotional language and were able to frame their perception of COVID-related threat with greater confidence and awareness. These findings, although circumscribed, respond positively to the urgent need to develop emotional support programs targeted at people with ID.

Keywords: intellectual disability; emotions; COVID-19; training; creativity; cooperation; group

1. Introduction

1.1. COVID-19 and Intellectual Disability

The health emergency linked to the spread of the COVID-19 has had and continues to have important global implications, leading to more than 750,000,000 cases all over the world [1]. The health impact of the pandemic is even greater for some fragile populations, including people with intellectual disability (ID). For example, the results reported by the largest study on the effects of COVID-19 on ID highlighted that people falling in this category were 2.75 times more likely to die after the initial diagnosis [2]. A subsequent cross-sectional study [3] showed that having an ID was, after age, the strongest independent risk factor for a COVID-19 diagnosis and mortality.

However, in addition to the immediate effects of the pandemic on physical health, important social and psychological consequences have been observed over time. Indeed, the feeling of uncertainty, the fear of contracting the virus, and social isolation have also impacted mental well-being and the possibility of receiving social support [4–7]. People with ID were particularly exposed to these threats. For example, a quasi-experimental study ran in The Netherlands [8] demonstrated that, after the imposition of lockdown measures, the number of reported adverse events increased, especially those involving aggression. Moreover, a qualitative study using semi-structured individual interviews revealed three main themes around the impact of COVID-19 on people with ID [9]: first, the lack of physical contact and the proximity of loved ones; second, the changes of routines due to being housebound; and third, the presence of difficulties in understanding the preventive measures. As already pointed out by Courtenay and Perera [10], cognitive impairments can limit understanding of rules, making the charge on the caregivers even greater.

Different studies highlighted the impact that all these difficulties had on family care-givers, revealing a high prevalence of depressive symptoms [11], stress, and other mental

issues [12,13]. Moreover, Bailey and colleagues [14] found that informal caregivers often experienced reduced social support to face change in routine plans, but also the exacerbation of behavioral problems. In addition, parents and proxies are often elderly and then need to be considered frail themselves [15].

In Italy, care assistance can be provided in support of families by socio-educational centers, which in many cases constitute one of the few opportunities for adults with ID to get together. The suspension of activities due to lockdowns has deprived users of the opportunity to engage with their peers in both structured and unstructured social-educational activities. The breakdown of routines and sociality can have a serious impact on fragile people's quality of life [16] due to the loss of other meaningful and purposeful activities [17,18].

However, scientific studies have shown that, despite the difficulties outlined above, in some cases people with ID were still able to maintain a good level of social satisfaction during the pandemic through the use of technology [16], highlighting the importance of digital support to maintain social contact. Additionally, no differences between evaluations before and after the COVID quarantine were found by Bailey and colleagues [14] in terms of parental psychological distress, life satisfaction, or behavioral problems. Nevertheless, these may not represent the case of people with more severe ID with lower levels of personal autonomy or greater impairment of the emotional-relational sphere. It has been suggested that the level of emotional development correlates with the severity of ID [19].

1.2. Emotions and Intellectual Disability

Although some studies have shown that children with ID exhibit emotional competencies comparable to their peers, they usually considered rather basic competencies, such as assessing the dimensions of valence and arousal [20]. When, instead, more complex competencies are involved, children with ID manifest some difficulties [21,22] that can persist through adolescence [23,24] and adulthood [25–27]. A review by Scotland and colleagues [25] highlighted that, compared to control groups with typical neuro-development (TD), adults with ID displayed relevant impairment on at least some of the tasks.

To contextualize the emotional impairment of people with ID, two hypotheses have been proposed: the first, the specificity hypothesis, argues that the difficulties shown in the emotional sphere cannot be solely explained by cognitive deficits, and therefore they represent a specific issue [28]. The second, on the other hand, argues that because some basic skills are intact, difficulties emerge as cognitive demands increase [29]. Empirical research has not arrived at conclusive results, but it appears that difficulties, with different degrees of severity, are often present even in the case of fairly simple tasks [26].

Additionally, it has been demonstrated that the difficulties experienced by people with ID in the emotional domain, and especially in interpreting self and others' emotions, can be linked to negative experiences in the relational field [21,30]. On the other hand, a proficient development of emotional skills is associated with better social interactions with peers [23,31]. Additionally, it has been proven that affective states have a significant impact on some cognitive capacities, such as attention [32].

Although little research has tested the efficacy of specific training in emotional competencies, it has been shown that they can lead to significant benefits and improvements [33] for children [34], adolescents [35–37], and adults [38–40]. These programs tested different components, ranging from emotional recognition [34], emotional expression, emotional intelligence, and social-emotional learning by using heterogeneous techniques, such as discrete trial training methodology, computer-assisted procedures, dialectical behavior therapy, and drama therapy. Typically, the chosen setting is the group and in only some cases it involves individual settings.

For example, recent research by Adibsereshki and colleagues [37] explored the effects of emotional intelligence training on the adaptive behaviors of adolescents with ID as measured with The Vineland Adaptive Behavior Scales (VABS). The analyses showed

that after 22 sessions there was a significant improvement in VABS scores, proving that emotional competencies can be exercised with proficient outcomes.

1.3. Aims and Hypotheses

In our previous experience in special educational settings, we demonstrated the existence of a relationship between emotional, cognitive, and creative skills in people with ID [41]. Leading our research in a multi-disciplinary team in collaboration with a socio-educational center, we have developed the hypothesis that working on the emotional dimension can have a wide positive impact on the quality of life of people with ID. Indeed, increasing the ability to cope with negative emotions could not only increase subjective well-being but also improve relational competencies and cognitive performance.

However, to our knowledge, no previous studies used cognitive-led training targeting multiple skills in an ecological setting, nor have they adopted this perspective using a systematic approach based on scaling training that can be tailored to the user's ability. This is important to us since, within the group, everyone can benefit from the contribution of all members.

Thus, we developed a training program that could be used in this peculiar setting, intending to test its feasibility and validity during a very emotionally demanding period, such as the one we experienced during the COVID-19 pandemic. We aimed to (1) evaluate the emotional impact of the COVID-19 pandemic on this group of people and to (2) test the feasibility and effectiveness of cognitive-driven emotional training. Finally, we wanted to (3) verify if similar training could help develop specific competencies to cope with the COVID-19 situation, and how these could change how participants perceive the pandemic threat.

We expected:

(1)   To find a feeling of fear and isolation before the training program;
(2)   That the training could be effective in encouraging cognitive reappraisal of emotional experiences. In detail, we predicted participants would report experiencing less negative emotion, particularly fear, and to improve their ability to express feelings freely.
(3)   To observe a new feeling of support and higher awareness after the training.

2. Materials and Methods

2.1. Participants

Eight adults with ID, five men and three women (M_{age} = 33.13; SD = 10.02) who refer to an Italian socio-educational center of the social cooperative society Arché Onlus (Inzago) took part in the research. The diagnosis of ID for all participants was made following neuropsychiatric evaluation by the dedicated regional services. Access to the service occurs voluntarily after the age of 18. Inclusion criteria for the present research were: (1) diagnosis of intellectual disability (based on ICD criteria); (2) consent to participation by the legal representatives and the participants; (3) full-time access to the facility. Exclusion criteria were: (1) insufficient language skills to understand verbal instructions and interact with trainers and peers; (2) insufficiently stable attentional skills (sustained attention deficit) to warrant test administration or participation in the training program sections (at least half an hour); (3) presence of very severe intellectual disability (IQ < 35); (4) presence of other medical conditions that adversely affects attention or behavioral control (e.g., non-collaborative behavior).

All participants were right-handed. They all had normal or corrected-to-normal visual acuity. Participants and their legal representatives have been informed of the research procedures and purposes. The study was conducted with the understanding and written consent of each legal representative according to the Declaration of Helsinki and with approval from the Ethical Committee of Università degli Studi di Milano (Protocol code: 1722).

2.2. Instruments

2.2.1. Assessment of Emotion

Test of Emotion Comprehension (TEC): The TEC [42] was devised to assess the development of the nine components of emotion, from recognition of facial expressions to understanding moral emotions. For the present study, we used the Italian version of the tool [43]. It consists of a picture book composed of 23 cartoon scenario boards and is available in both male and female versions. For the first five boards, the task is to identify the correct facial expression corresponding to the target emotion, selecting one option from among four possible choices. The following boards depict a story represented at the top of the page whose main character's face has been left blank. The task here is to select the appropriate emotion for the story character from among four choices placed at the bottom of the page, based on the story read by the examiner. There is a subtotal score for each component, and a global score (which ranges from 0 to 9), which represents the acquisition of the nine components [44]. Even if the test is conceived for children, we chose it considering the mental age of our participants and its ease of administration. We could not find a simple test to assess emotions in adults whose degree of difficulty is consistent with our sample. In any case, the scenarios were not presented childishly, so we believed the items to be appropriate and familiar to our participants.

Emotion Visuo-analogical scale (VAS): A visual-analogic scale was created by taking inspiration from the Positive And Negative Affective Scale for children (PANAS-C; [45]). The scale was composed of 16 items selected from the original 27: four related to joy, four related to fear, four related to anger, and four related to sadness. All unnecessary or too difficult items have been removed. The participants were asked to indicate how often they felt each emotional state within the past 2 weeks by using a simplified Likert scale with just three steps (never, sometimes, often). Such amendments were designed and implemented to ensure adequate understanding of the participants.

Levels of Emotional Awareness Scale for Children (LEAS-C): The LEAS-C [46] is the adapted version of the LEAS [47] applied to developmental populations. We chose this version after carefully considering the mental age of our participants and their knowledge of everyday situations. For the present study, we used the Italian version [48]. The scale includes 12 scenarios that describe imaginary everyday situations. The participants are asked to describe the emotions that they and a hypothetical person could feel in that situation. The scoring is intended to assess the complexity of emotional awareness, which is organized in five levels, from the description of somatic features to a more complex emotional awareness (e.g., the inclusion of ambiguity and the presence of distinguished emotional state of the two characters). Then, two different scores are calculated: self-awareness scores and other-awareness scores, which can range from 0 to 48. The third index, the total awareness score, can reach 60. To score participants' responses, the glossary of emotion words was used.

Drawings: Participants were asked to draw a picture on a sheet representing their actual ideas and feelings about the pandemic and the coronavirus. They could use the sheet in every orientation, and choose among pencils, colored pencils, and markers. No time limit was given to allow participants to express themselves as freely as possible.

2.2.2. Appreciation Survey

To investigate the participants' appreciation and appraisal of the activities proposed during the emotional training, a simple and short survey was created. It included four questions that were read to the participants individually: "How much did you enjoy the emotion training?"; "How much did you enjoy working in groups with your peers?"; "Do you feel you learned new things?"; "Would you like to do similar activities in the future?". To answer these questions, they could use a 6-point Likert scale ranging from "Not at all/Any", to "Very much". The scale was accompanied by a visual-analogic scale with emojis representing different emotional expressions in ascending order. The participants could either point to the chosen emoji or answer the question using a verbal label.

2.2.3. Training Program

The training program consisted of five 90-min weekly sessions. Each session was typically composed of three 30-min activities. Participants were divided into two small groups due to safety guidelines. One group received the training in the morning, and the other one in the afternoon. Two professionals, a psychologist, and an educator conducted the sessions. The topics of the sessions were intended to train different aspects of emotional awareness in ascending order of complexity. The demands concerning interpersonal engagement have also been adjusted, starting with more structured activities, and progressively creating more opportunities for cooperation and negotiation. The activities included psycho-educational techniques, among which were group brainstorming, competitive games in teams, and individual tasks, as well as different expressive modalities such as cognitive tasks, painting exercises, role-playing, use of recycled materials, storytelling, construction of small objects (puppets, boxes...), and simple experiments. Some activities were taken from specialized books, while others were invented by the trainers based on participants' needs and interests.

The first session was called "The ABC of Emotions" and was intended to define emotions and frame the topic. The first activity was a team game: the participants, subdivided into two teams, were required to locate the sensations read by the trainers (itching, anger, tingling, shame, and chills) in the body or heart using colored dots and pasting them on the board; (see Di Pietro and Dacomo, [49] (pp. 53–54)). The second activity was another team game aiming at differentiating emotions among those which make one feels good or bad (taken and modified from Di Pietro and Dacomo, [49] (p. 57)). The trainers read hypothetical scenarios and the participants, in teams, had to categorize them by placing the tokens on the board. The third and last activity was an individual task: participants received a photocopied sheet representing a Mandala in black and white (see Di Pietro and Dacomo, [49], (pp. 61–62)). In the center are little petals on which they could pin people, hobbies, or values that make them feel good, and then color the drawing.

The second session was intended to explore the spectrum of emotions, and was, thus, called "The Rainbow of Emotions". The session started with brainstorming about the different kinds of emotions. Then, the second was a handicraft activity. Participants were given a completely white shoebox that they had to customize. On the lid, they had to write their name, and on each side, they had to take inspiration from the four principal emotions previously analyzed (anger, fear, sadness, and joy). They could use tempera to identify kindred colors or glue paper figures that had been previously cut out from newspapers and magazines. The box would then be used to collect all the materials produced by participants during the following activities. This session ended with an individual task, the production of emotion puppets by using claws, paper circles for the face, markers, wool threads, and other waste material for the hair, clothes, and other details.

The third session was intended to explore the topic of emotional intensity and was called "The thermometer of emotions". The first activity was a participatory reading: the trainers read the story of Nonimporta (similar to the English form: "Nevermind"): the protagonist suppresses feelings by hiding them in clothes without expressing them, until they burst (taken and modified from Sunderland, [50]). On the table, there are fabrics and "uncomfortable" materials (e.g., tinfoil balls) that the participants could choose and hide under their clothes to simulate the accumulation of emotions as the story progressed. A brainstorming was proposed after the activity by asking participants how they felt with all those overflowing emotions on and trying to figure out why it is important to express them with someone we trust. The second activity required participants to draw a giant thermometer on a panel and then to locate in the right position different levels of the same emotions by using emoji or photographs taken from magazines (inspired by Di Pietro and Dacomo, [49] (pp. 59–60)). The third one was an individual task: participants were given a photocopy with drawings (from Sunderland, [50] (pp. 42–43)) that depict, in black and white, natural disasters or fantastic creatures to represent how they may feel when

emotions are too strong (storm, stormy sea, and monster). They could choose their favorite one(s) and complete it with color.

The objective of the fourth session was to understand that it is possible to feel several different emotions at the same time, as well as ambivalence or the need to hide emotions or replace them with other ones ("The Collage of Emotions"). For the first activity, the trainers showed an ambiguous figure (Two-Faced Janus: taken from Di Pietro and Dacomo, [49], (p. 64)) asking if it was happy or sad. After a brief brainstorming session, everyone received a Two-Faced Face card, chose whether to use it faced up or down (sad or happy), and colored it, indicating who the character was and why they felt that emotion. In the second activity, named "The Emotional Potion", the trainers created, advised by the participants, a potion for each emotion by choosing the right colors (with brainstorming to motivate the choice). After that, everyone received a small jar and created their cocktail by choosing the right dose of each emotion, according to how they felt at that moment.

The fifth and final session aimed to understand that emotions derive from thought and that by acting at the level of thought it is possible to modify them, adopt other points of view, and find solutions ("Managing emotions"). The first activity consisted of a team game: the trainers pasted on the board four icons representing: FACT—THOUGHT—EMOTION—RESPONSE (inspired by Di Pietro and Dacomo, [49], (p. 66)). The participants had to reorder four frames (taken from the animated film Peter Pan) following the scheme: the fact (what is happening), the thoughts (elaboration of possible strategies/how should I behave, what will I do?), the emotions (what do I feel?), the choice (do I respond appropriately?). The second activity was another team game similar to the Goose Game (from Di Pietro and Dacomo, [49]). In two teams, participants had to roll dice, draw a card, and answer questions about hypothetical emotional situations. The last activity consisted of group sharing: The workshop ended with participants picking and placing a shell in a common jar communicating to others something that made them happy.

2.2.4. Procedure

The action research was conducted through a mixed-method design involving both a quantitative and a qualitative approach. The combination of these two methodologies was discussed within the research team and proposed to ensure both explicit and implicit measures. This choice was made mainly for three reasons. First: considering participants' different levels of language skills (although considered appropriate for an adequate understanding of all the assessment tools), it was important to also offer non-verbal tasks to assess their emotional states. Second, we wanted to exclude a possible effect of complacency on the researchers in the face of direct, verbally posed questions. In the case of implicit measures (drawings), the free expression of the participants without a specific request (except the theme to be represented) allowed for a more authentic reading of their meanings. Third, it was important for the whole team to assess individual differences in the approach towards the COVID-19 pandemic and, in general, the coping attitudes to planning targeted activities within their educational path.

For the quantitative analyses, validated tools have been selected that were appropriate for the participants' mental age (see Section 2). When needed, they were associated with integrative, simplified materials (such as emoji in the case of Likert scales) that ensured adequate understanding. The scoring was conducted by a psychologist who was not aware of the experimental condition (pre vs. post-training performance).

The qualitative analysis was conducted following a phenomenological approach. The applied operational model is the "Polysemeiotic Model" (Modello Polisegnico, [51]). For each drawing, a report was produced considering the graphic elements in the paper (see also [52,53]). In detail: line (tract, pressure, pattern); materials (tempera, pencils, chalks, watercolors, collage, mixed technique); shape (open/closed, round/edged); space (high/low, left/right, empty/full, perspective, direction, crowding, balance, articulation); color (warm/cold, light/dark, contrasts, black/white, saturated/unsaturated). A certi-

fied art therapist not aware of the aims of the research and not involved in it evaluated the drawings.

To assess the effectiveness of the training we compared each participant's pre- and post-training performances (within-subject design) on both qualitative and quantitative measures.

3. Quantitative Analysis

Results and Discussion

To investigate the presence of improvements after the training program in the performance of the quantitative tests (questionnaires and tests), we performed Wilcoxon Signed-Rank tests for all eight dependent variables: four for the emotional components of the VAS, one for TEC score, and three for LEAS (self-awareness, other-awareness, total score). The analyses identified three significant results about LEAS-C self-awareness ($p = 0.027$), other-awareness ($p = 0.027$), and the total score ($p = 0.046$), with all variables improving after the training program (SELF$_{pre}$: M = 32.86; SD = 7.86. SELF$_{post}$: M = 37.29; SD = 6.47. OTHER$_{pre}$: M = 29.29; SD = 8.83; OTHER$_{post}$: M = 37.57; SD = 6.55. TOT$_{pre}$: M = 34.71; SD= 7.87. TOT$_{post}$: M = 38.71; SD = 6.02). No significant differences have been found between self- and other-related scores, neither within pre- nor post-assessment (see Figure 1).
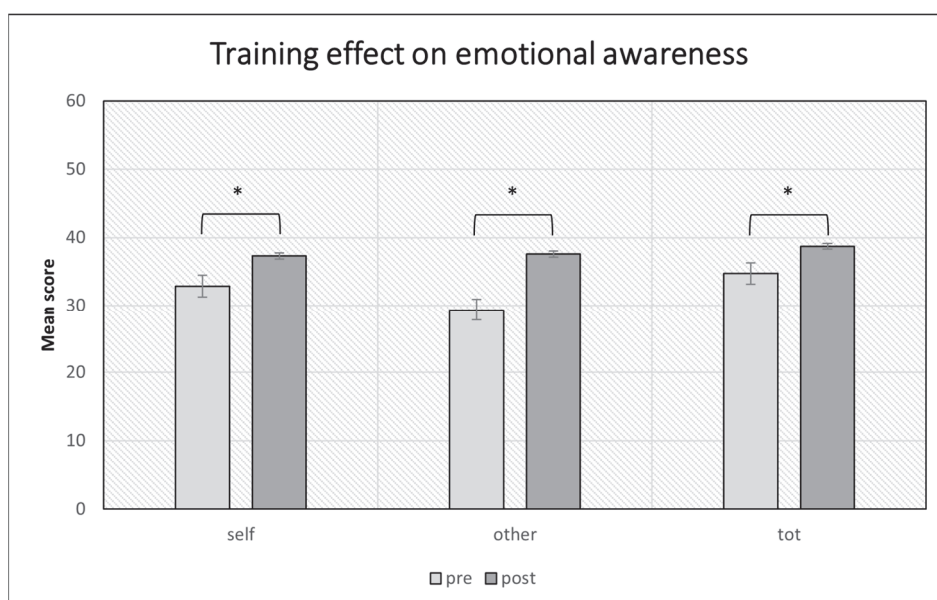
Figure 1. Historagrams representing mean scorings at the LEAS-C for self, other, and total subscales as assessed during pre- (white) and post-training (grey) assessments. The data show significant improvements in the three measures after the training.

Moreover, the analyses highlighted two results close to statistical significance: TEC scores ($p = 0.058$) were higher after the training program (TEC$_{pre}$: M = 4.75; SD = 2.12. TEC$_{post}$: M = 6.38; SD = 0.74), while the self-assessed scores of fear with the VAS ($p = 0.074$) were lower after the training program (FEAR$_{pre}$: M = 2.63; SD = 2.13; FEAR$_{post}$: M = 1.38; SD = 1.6).

Finally, data from the Appreciation Survey were considered to assess participants' liking of the activities, which could be useful to plan future activities. None of the participants answered "Not at all/Any" or "Little" to any of the questions. The "Very much" answer obtained 62.5% of the votes in Question 1 (Q1: "How much did you enjoy the emotion training?"), 75% in Q2 ("How much did you enjoy working in groups with your peers?"), 50% in Q3 ("Do you feel you learned new things?"), and 100% in Q4 ("Would you like to do similar activities in the future?"). See Table 1 to see the results for each question.

Table 1. Percentage of participants who rated the various levels of the Likert scale for each of the proposed questions.

Question	Answer					
	Not At All	Not Much	So-So	Enough	A Lot	Very Much
How much did you enjoy the emotional training?	0%	0%	0%	12.5%	25%	62.5%
How much did you enjoy working in groups with your mates?	0%	0%	12.5%	0%	12.5%	75%
Do you feel you learned new things?	0%	0%	0%	12.5%	37.5%	50%
Would you like to do similar activities in the future?	0%	0%	0%	0%	0%	100%

The quantitative analyses highlighted the presence of a significant improvement in participants' emotional awareness. Indeed, results showed higher scores in all three indices of LEAS-C, related to both self and other-related awareness of emotions. Higher scores suggest more sophisticated mindreading and the ability to infer and verbally express the characters' emotions. This result is particularly meaningful since it could indicate that the training program was effective for the participants, who showed to be more aware of their and others' emotions. This is in line with the results obtained by previous research. For example, Adibsereshki and colleagues [37] found that, after a program based on a computerized emotional intelligence group training, communication and social skill competencies were significantly improved. The development and/or improvement of such competencies can reinforce the capacity to make sense of ones' own thoughts and behaviors, and possibly a more proficient regulation of emotional states. At the same time, enhanced abilities to interpret the emotions of others can provide an important tool for understanding others' intentions and behavior, thus empowering solving problems, conflicts, and ambiguous management. Additionally, our results seem to indicate an improved capacity to discriminate between our own and others' feelings, which may suggest the presence of other important skills, such as perspective-taking. Finally, these improvements are observed in the context of an abstract task, which requires participants to use their imagination, without any concrete visual aids, such as photos or drawings, or actual events for which they could have used their experience. All these skills are particularly relevant for our participants since an important cognitive impairment is present besides the emotional difficulties.

Two interesting tendencies that did not reach statistical significance deserve attention because they could inform future research and intervention. The first one refers to TEC scores, which were improved after the training. In detail, before the emotional activities, the participants demonstrated less than five competencies (M = 4.75) out of nine. After the training, they gained more than one extra skill on average (M = 6.38). Additionally, considering the VAS assessment, coherently with our hypotheses, fear is the most permeable to the effects of training, even if our results did not reach a statistically significant level. This point is nevertheless relevant in that it not only supports the efficacy of the training, but it also proves that the training program was pertinent to the difficult period they were experiencing and thus was actually needed. We suppose that setting a non-judgmental and safe space could have provided proficient support, reducing the sense of fear. However, one could argue that the fear scores were reduced because the situation improved over time and participants felt more secure. Even if it were plausible, we excluded this possibility since participants had already resumed routines more than a couple of months before, and the training lasted little more than a month, so they were rather used to the new procedures.

Nonetheless, although these findings are vital since they contribute to demonstrating the efficacy of our training, it is equally important to analyze the individual outcomes. Indeed, participants exhibited unique and differential characteristics. Considering LEAS-C scores first, it is worth noticing that some showed a marked difference between self and other-focused emotional competencies, while others had comparable performance in the

two domains. Interestingly, although all participants showed improved performance, people who started at a lower level often manifested substantial gains (e.g., 25 to 40 points before and after the training). Similarly for TEC, considering each participant more in detail we can observe that in some cases the performance in identifying emotional components increased from 2 to 7 or 3 to 7 skills, highlighting a gain of 4 or 5 extra competencies. Indeed, also in this case, participants who started with lower scores in emotional understanding demonstrated a huge increase in performance, while those who started with higher scores exhibited more moderate gains.

With regard to the fear scores, three participants in detail displayed a significant decrease in fear assessment, dropping from 6 to 3, from 5 to 2, and from 3 to 0. In one other case, on the other hand, there was a slight increase in anger and fear scores and a substantial increase in sadness scores. In this case, considering the participant's background and emotional competencies, the educators and the researchers have concluded that such an increase could result from a greater willingness to embrace and acknowledge emotions, and a greater openness to their feelings. Moreover, they demonstrated much interest in the training program and were very enthusiastic about the idea of participating in similar activities again in the future, so we believe the experience was meaningful and proficient.

All these findings derive from the choice of operating within groups that are rather heterogeneous in terms of cognitive and emotional skills. This choice, while aimed at greater social inclusion and fruitful exchange between individuals with different characteristics, can certainly account for the observed effects. On the other hand, they reveal how starting skills affect the outcome of a training program and suggest the importance of educators and therapists in developing tailor-made pathways and activities.

4. Qualitative Analysis

Results and Discussion

The phenomenological evaluation of the drawings by the art therapist permitted the identification of some recurring topics of interest about participants' perception of the COVID-19 pandemic.

The first aspect (1) is about the presence of a shift from a representation of closed or semi-closed circular shapes containing different elements to the realization of subjects free from containers (see Figures 2 and 3). This choice seems to indicate an emotional change from a state of need for protection and isolation to one of greater trust in the environment and relationships (Participant02, Participant03, Participant04).

The second element (2) concerns the presence of a change in the representation of the Coronavirus (see Figures 4 and 5). It shifted from an approximate description to a sharper and more defined one, as if the training program had given the participants the possibility to develop greater awareness of what is happening and what it arouses in themselves (Participant01, Participant02).

A third point (3) reflects the presence of a change in the structuring of space. We observe a shift from the presence of graphic elements that block, to their disappearance in the next phase (see Figures 6–8). Thus, we can hypothesize a change in feelings: from the sensation of being blocked by the health emergency to one of greater awareness of the danger, but with a possibility of managing it without feeling merely stuck and powerless (Participant05, Participant06, Participant07).
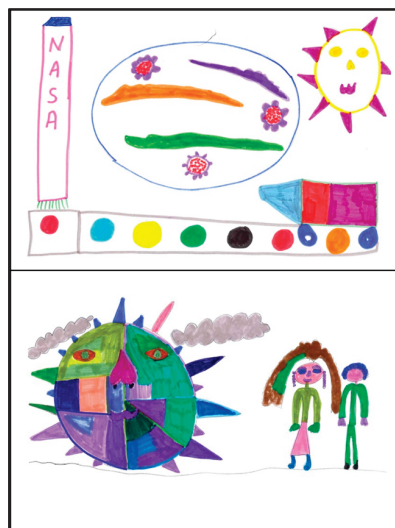
Figure 2. Drawings of Participant03 during pre- (**top**) and post-training (**bottom**) assessment. In the first drawing, they create a human figure within a structure that contains it. The same character merges with the lines of the structure, giving the impression of being stuck in the lines and shapes above. In the second work, they draw two people without protection around, still filling the entire space, which, however, is less confusing. In both works, a shape (possibly a mask?) hides the mouth of the figure, that in the second work is much more evident. The message here is: "I unlock myself".
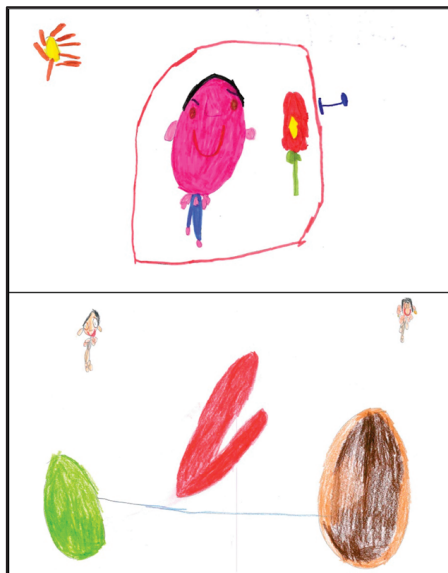
Figure 3. Drawings of Participant04 during pre- (**top**) and post-training (**bottom**) assessment. Here, we observe a shift from the presence of a container (circle/house) to the absence of containers and the freedom of the figures placed in an organized way. There is also a transformation in the representation of the relationship, which moves from a contained bond to a relationship that does not need protection. The message in this case seems to be: "I can go out without getting lost".

Figure 4. Drawings of Participant01 during pre- (**top**) and post-training (**bottom**) assessment. In the first work, they draw a circle within other patches of color that create a sort of frame with an opening at the base. In the second work, they reproduce again a circular shape in the center of the sheet, but much better defined, with eyes, nose, and mouth: an animated shape. Another colored circle appears, with a very strong stroke that completely isolates the figure inside. While in the first work on the central element barely features a facial expression of fear, in the second drawing the expression is sharp, the mouth has downturned corners, and is starry-eyed. The message is: "I set you up ugly COVID!".

Figure 5. Drawings of Participant02 during pre- (**top**) and post-training (**bottom**) assessment. The first drawing presents concentric circles that occupy most of the space of the sheet. At the center of the concentric circles, we find small elements that are also circular. We can see how the stripes of color repeated on the sheet seem to be barriers to the central body. In the second drawing, they create something quite opposite. Of the previous concentric circles, just one remains to represent a face. Here we perceive a feeling of clarity, sharpness, and stability even though there are no supporting planes for the figure. The message could be: "It is all clearer now".
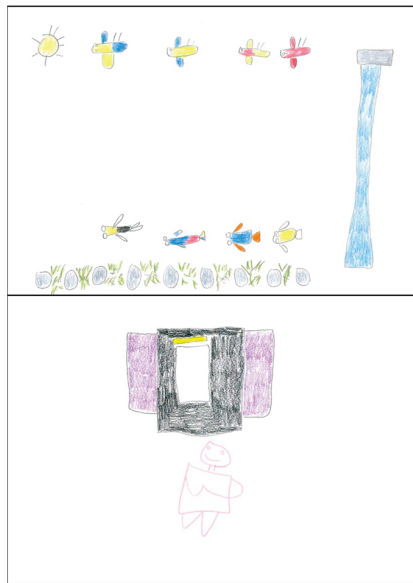
Figure 6. Drawings of Participant05 during pre- (**top**) and post-training (**bottom**) assessment. Before, they draw some elements: fluctuating figures at the top and the bottom of the sheet, almost as if to create a frame. On the right, there is a rectangle that closes the space. In the second phase, a closed figure appears in the center of the sheet above a human figure who appears unaware of the heavy structure that hangs above. In the first drawing, the block on the right side suggests a difficulty in glimpsing the future and the possibility of going only towards the past (all the figures are turned left). In the second work, there are no side blocks. The looming of something heavy above the head of the character is evident, centered in the sheet. The message is: "I am present in what happens".

Figure 7. Drawings of Participant06 during pre- (**top**) and post-training (**bottom**) assessment. First, they draw rectangles that delineate the space to the left as if to categorically block the movement of the central cell. The sun and the colored rectangular shape also act as a block. Framed and blocked in the center of the support there is a suspended circular form with other circular and oblong elements inside. In the second work, two human figures appear beside a large circle. It looks like a figure born from the fusion of the sun and the previous cell as if they had merged, giving rise to a new shape that is disturbing and dangerous for people nearby. The colors are dark and cold like the elements inside the first circle/cell, but the shape is that of the first sun. Thus, in this case, we could perhaps support the hypothesis of a shift from a graphic representation of control of the cell/circle to a representation of a dangerous situation for oneself and one's loved ones, which is no longer controllable. The message is: "I can't help it".

Figure 8. Drawings of Participant07 during pre- (**top**) and post-training (**bottom**) assessment. In the first work, they draw a house, a tree, three people, and geometric figures at the top of the sheet. The latter looms menacingly over the heads and roof of the house. In the second work, they draw two people, a house, a flower, and a large sun at the top. The structure changes little, although in the second work the figures at the top disappear and a large bright sun appears, looking less dangerous than the geometric figures in the first drawing. The message is: "I am less scared".

Finally (4), it is interesting to note a change in the drawings from the presence of several elements, some of which are about each other, to the absence of them or the persistence of only one of them (see Figure 9). This step could suggest the creation of a space where one can experience an increased sense of isolation and especially sadness contextual to the pandemic (Participant08).

Figure 9. Drawings of Participant08 during pre- (**top**) and post-training (**bottom**) assessment. In the first work, there are several graphic elements: the building with the cross, the ambulances, and flying elements of the same color as the building. Everything is suspended, colored with markers, and cold colors prevail. In the second one, there is only one element, placed at the center of the defined support and leaning on the floor; therefore, it is more stable and more realistic. The entrance door appears, which was not there before. Around the structure with the cross on top, there is nothing. It suggests a sense of loneliness, emptiness, and sadness, and all other elements disappear. There is a shift from a representation of several elements concerning each other to a work made up of an isolated element in the center of the paper. The message is: "I am sad".

A previous qualitative study used semi-structured individual interviews to investigate the impact of COVID-19 on people with ID [9] and highlighted three main themes that are compatible with our analyses. The first is the lack of physical contact and the proximity of the loved ones. The presence of this theme is suggested in our study by the use of closed or semi-closed circular shapes, which have been interpreted as the need for protection and isolation. The second is the forced changes to everyday routines due to the lockdown. In the present research, this topic was conveyed by the presence of looming elements and the sensation of being blocked by a health emergency. Third and finally, the presence of difficulties in understanding the preventive measures which are, in our case, represented by an approximate description and definition of the coronavirus, which was interpreted as a lack of awareness of the situation.

5. General Discussion

The combination of quantitative and qualitative analyses allowed us to draw general considerations about the group as well as personalized indications to guide future educational work. Additionally, it permitted us to answer our research questions. The first question (What is the emotional impact of the COVID pandemic on this group of people?) can be answered by quantitative and qualitative data. The first suggested the presence of a high level of fear before the training program, which is reflected by the second through the use of graphic elements in the drawings that suggest isolation, danger, and the need for protection. The second research question about the efficacy of the training program was addressed, mainly by the quantitative analyses and the results at the LEAS-C, which highlighted the use of more complex emotional language after the training program, considering both self- and other-perspectives. The third question (How can the training modify the perception of the COVID-19 threat?) was addressed mainly by the qualitative analyses, which underlined that after the training program, the drawings were characterized by new elements suggestive of higher confidence (less need for protection; 1) and awareness (2, 4) about the threat, together with a more free emotional expression (3).

Interestingly, when looking at single outcomes, there is a parallelism between the emotional state profile as assessed by the quantitative tools and the drawing construction. For example, the participant representing a desolate scenario of the pandemic after the training was also the one who experienced higher negative feelings.

6. Conclusions

The present study aimed to assess the efficacy of a mixed-method approach to both assess and empower emotional skills in a small sample of adults with ID who attend the activities proposed by a socio-educational facility. The study was conceived in a specific historical moment, that is, the COVID-19 pandemic, with the idea of providing adequate support and tools to a group to manage the uncertainty and the difficulties related to the restrictions and changes in everyday life. Adults with ID represent a population rather neglected from the psycho-educational point of view and especially by institutions. We believe, however, that, particularly in this delicate period, it is essential to direct interventions that encourage the support of specific skills to deal with uncertainty, to implement group cohesion, cooperation, and sharing of feelings with others.

The emotional training program, based on a cognitive approach and led with creative methods, was made up of many different techniques and covered emotional topics and skills with an increased level of complexity. The comparison between the quantitative assessment before and after the training program allowed us to appreciate the effectiveness of the training, highlighting the presence of empowered competencies, especially in emotional awareness, revealing a more complex use of the emotional lexicon. At the same time, the analyses revealed a wide heterogeneity in the outcomes, which was better highlighted through a phenomenological analysis of the drawings of participants' representation of coronavirus.

In light of these results, we believe that our study, although limited to a small setting, may have important implications for developing future research. Of course, it is not free from limitations. Although well characterized, the sample is modest to ensure the generalizability of our data to the entire ID population. However, considering the variety and heterogeneity of this specific population, it would be a very ambitious aim even with a larger sample. We believe that, by extending methods and practices to real ecological contexts, it would be possible to further prove, assess, and challenge methodology both from us and other researchers in the field.

Despite these criticisms, the research presents many aspects of innovations. First, it proposes an innovative and effective training program in emotional competence enhancement based on cognitive stimulation techniques through creative and expressive means [41,54]. The training program proved to be particularly popular with participants, who appreciated the playful and varied ways of leading the activities.

Additionally, it was conducted in an ecological setting, within an existing group of people who know each other and participate in the activity of the center together every day. This way, the skills acquired during the training can be continued and reinforced with the support of educators in other activities as well.

Future developments in this line of research, in addition to help increase the numerosity of the action research, could include the assessment of skills other than emotional ones, to investigate the generalization of learning to other areas, such as cognition. Moreover, they could also take into consideration educational personnel, with specific training courses on various topics of interest.

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Article

Research on the Contribution Mechanism of Vocational Human Capital Characteristics to Income

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Abstract: Vocational education is an important way to accumulate human capital. Human capital is the core element of economic growth and has huge positive externalities. Building a scientific and effective human capital development system is an important driving force to improve workers' living standards and promote innovative development. Based on statistical techniques such as Lasso dimensionality reduction, stepwise regression, and partial least squares, as well as on the 2012–2016 China Labor Force Dynamics Survey (CLDS), this paper studies the impact of human capital on workers' wage income and capital income, and establishes an income-determining equation that can be used for interpretation and forecasting. The empirical results show that education, professional skills, health, and communication ability are important components of human capital and are significantly positively correlated with income. China should build a good and effective human capital development system to increase workers' income and narrow the income gap among residents.

Keywords: human capital; vocational education; career development system; income

1. Introduction

Human capital plays a crucial role in driving innovation and economic growth. An effective evaluation system for human capital is crucial for fostering innovation in society. The importance of human capital training lies in improving individual income, reducing income inequality, boosting industrial innovation, and enhancing national competitiveness [1–3].

Vocational education has become a subject of increasing concern globally, due to the need to enhance the employability of vocational education graduates. The world is facing ecological, social, and economic changes, and a highly skilled workforce is crucial for sustainable development. In the knowledge economy, new types of human capital may be needed in low- and middle-income countries, and vocational education can provide necessary professional qualifications that are not available through general secondary education. Investing in vocational education is a means of boosting economic competitiveness and alleviating poverty [4,5].

This article aims to address the critical issue of human capital evaluation and the research gap regarding vocational education. The research framework consists of relevant literature review; data and sample description; statistical analysis using Lasso dimensionality reduction, stepwise regression, and partial least squares; regression analysis; and policy recommendations. The article is organized as follows: Section 2 reviews the relevant literature, Section 3 describes methodology and data, Section 4 analyze the results of regression analysis, and Section 5 provides conclusions and policy recommendations for talent development.

2. Literature Review

From the perspective of individuals, unique competitiveness is a key factor in developing a specialized talent. Research by Zhu (2013) has pointed out that the development of talents is related to high-quality, outstanding creativity, and outstanding workability [6]. Specialized talents can be defined according to four dimensions: behavioral ability, knowledge reserve, skill mastery, and competence. Therefore, the essence of specialized talents are also their human capital accumulation. Talents are a core component in the competitiveness of individual income sources and an important driving force for economic growth. The 2013 Human Development Report and previous reports have pointed out that economic growth itself cannot automatically translate into human development and progress [7]. Only through poverty alleviation policies involving education, nutrition, health, and work skills and a large amount of investment aimed at improving people's abilities can a government expand the number of opportunities to obtain decent work and ensure the continuous progress of humans. Both lecturers and students need to prepare for the future workforce. Various studies have highlighted the importance of digital competencies, such as digital literacy and innovative tools; however, the shift of innovative technology applications in industry to existing higher education programs often occurs rather slowly. Industry and higher education institutions need to collaborate and communicate extensively to prepare students for future jobs, and lecturers play a crucial role in this transition [8]. Promoting the accumulation of human social capital and improving the talent development system through various methods are also important goals toward income increases and economic growth.

From the macro perspective, technical talents can promote innovation and a country's development. From the individual perspective, they can rely on their human capital to obtain income from the market. This article intends to explore the core factors that contribute to income from the level of individual income to develop corresponding suggestions for talent development.

Regarding the impact of human capital characteristics on workers' income, Chinese and foreign scholars have conducted a series of studies. The most representative ones are from Schultz [9], Mincer [10] and Becker [11]. Following their research, they believe there is a significant positive correlation between people's level of education and income. In terms of education investment, the higher the level of education, the smaller the income gap between people, and the lower the level of education, the larger the income gap. Kartini and Weil recognize the importance of nutrition and health to human capital and believe that health human capital increases the income level of farmers and can prevent farmers from falling into a poverty trap [12,13]. Gao and Yang (2006) believe that vocational education and on-the-job training will contribute more to farmers' income than basic education [14]. Different characteristics of human capital produce corresponding contributions to the incomes of different groups, so measuring the contribution rate of different characteristics of human capital to income can provide corresponding guidance for the talent development system.

The application of machine learning methods in research on human capital and its contribution to income is relatively new. Most existing studies rely heavily on databases and survey data, and prior information is used to guide the research and model development. This approach, however, becomes less effective in the era of big data, when it becomes increasingly difficult to obtain reliable prior information. In such a scenario, data mining methods can provide a valuable solution to help researchers understand the problem and advance scientific knowledge [15,16]. In this context, we plan to introduce machine learning methods to research on the effect of human capital on income. Our research will focus on the microdata of the Chinese labor force dynamics survey, which provides a rich source of information on human capital and income. In order to extract useful insights from this data, we will use Lasso for variable selection and dimensionality reduction, as well as partial least squares and stepwise regression to construct an income-determining equation. This equation can then be used for interpretation and forecasting purposes. One of the

advantages of using machine learning methods is that they can help researchers identify important variables that are not included in the prior information. For example, Lasso can help reduce the number of variables by identifying the most important ones, while partial least squares and stepwise regression can help integrate microdata and construct an equation that is able to explain the relationship between human capital and income. This can provide valuable insights into the effect of human capital on income, and help researchers understand the key drivers of income growth in the Chinese labor force. Overall, the integration of machine learning methods into research on human capital and its effect on income provides a new and innovative approach that can help researchers overcome the challenges of big data and advance scientific knowledge. By using the microdata of the Chinese labor force dynamics survey, we hope to make significant contributions to this field of research and provide valuable insights for policymakers and researchers.

Based on the spatial and temporal differences in China's economic development, this article uses stepwise regression, Lasso, and partial least squares to explore the differences in the effects of human capital characteristics on income and then explore the structural characteristics of the talent development system that the government needs to build. Our conclusions, based on the empirical research, show that the determinants of wage income are an efficient and practical skill education system, the worker's barrier-free communication skills, higher education level, and their own industry choices. High-tech industries have a higher return on income compared to traditional industries. Moreover, the determinants of capital income are more affected by education level, health status, and regional differences [17].

Therefore, the goals that should be achieved are to improve the current talent development system, strengthen public education investment, improve vocational skills training, develop high-tech industries, and promote population mobility and integration. The development of vocational education and high-tech industries is important for increasing wage income. Both have a greater impetus and help improve the human capital of the whole of society [18]. Some developing countries are currently pushing for vocational education and training as a way of building human capital and strengthening economic growth [19,20]. However, in reality, many of these countries' education systems, particularly those for vocational education, do not know which abilities to focus on nurturing. This could result in negative impacts on building human capital if expanding vocational education replaces academic education [21,22].

Compared with previous studies, this article is based on micro-survey data, with the help of statistical methods such as Lasso dimensionality reduction, stepwise regression, and partial least squares to construct an interpretable and predictable income-determining equation. Moreover, the previous literature seldom analyzes the impact of human capital characteristics on capital income, but, according to Piketty, capital income is an important component of income [23,24]. In developing countries, the rate of return on capital income is much higher than labor income, so this article also analyzes wage income and capital income, in an effort to find the difference between the determinants of the two. We hope to answer the following questions: What are the most significant human capital characteristics that have a significant impact on income? To what extent do education level, work experience, and professional skills contribute to income? What are the key differences between wage income and capital income, and what are the major factors that influence each?

3. Methodology

Too many independent variables will bring a dimension disaster; when the number of independent variables is greater than the sample size, the coefficient β cannot be estimated by the least square method. In addition, linear models also risk overfitting; at this time, if you use brand new data to verify the model, the effect is usually weak. Therefore, this article first uses the Lasso algorithm for dimensionality reduction [25].

3.1. The Principle of Lasso Regression

In linear regression, the common expressions are as follows:

$$\text{Assumption function}: \ h_\theta(x) = \theta_0 x_0 + \theta_1 x_1 + \cdots + \theta_n x_n$$

$$\text{Loss function}: \ J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta\left(x^{(i)}\right) - y^{(i)} \right)^2$$

$$\text{Objective function}: \ \min J(\theta_0, \theta_1, \ldots, \theta_n)$$

Y represents the dependent variable, X represents the independent variables, and θ represents the coefficient estimates for different variables in the above linear regression equation. Here, the θ_i represents the parameters (also called weights) parameterizing the space of linear functions mapping from X to Y. When there is no risk of confusion, we will drop the θ subscript in $h_\theta(x)$.

The lasso algorithm solves the problem of overfitting by introducing a regularization term (L1 norm, or ridge regression) in the loss function. The updated regression loss function is as follows:

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta\left(x^{(i)}\right) - y^{(i)} \right)^2 + \lambda \sum_{j=1}^{n} |\theta_j|$$

Lasso regression will cause the estimation of some regression coefficients to be 0; thus, by removing variables with regression coefficients of 0, lasso regression plays a role in variable selection. And λ is called the regularization parameter.

3.2. The Principle of Stepwise Regression

The basic idea behind stepwise regression is to introduce variables into the model one by one. After each independent variable is introduced, an F test is performed, and the selected independent variables are tested one by one. The originally introduced independent variable changes due to the introduction of the subsequent independent variable. When it is no longer significant, it is deleted. One must ensure that only significant variables are included in the regression equation before introducing each new variable. This article adopts the backward stepwise regression method.

3.3. The Principle of Partial Least Squares

The partial least squares method is a mathematical optimization technique that finds the best function match for a data set by minimizing the sum of squares of errors. This article explicitly uses the following PLSR algorithm to achieve this.

The PLSR (Partial Least Squares Regression) algorithm is a regression modeling method concerning multi-dependent variable Y to multi-independent variable X. In the process of establishing regression, the algorithm considers extracting the principal components of Y and X as much as possible. It also considers maximizing the correlation between the principal components extracted from X and Y.

3.4. Data and Sample Description

This study's dependent variable was residents' income, including wage and capital income. Wage income refers to all the labor remuneration obtained by employees through various channels, including the wages of their main occupations and other labor incomes obtained by engaging in secondary occupations, other part-time jobs, and sporadic labor. Capital income refers to after-tax operating income, including agricultural operating income (self-sufficient agricultural production needs to be converted into income according to market value) and business operating income, such as from shops and factories.

Among them, compared with wage income, the rate of return on capital income is higher; at the same time, for individual residents, capital income is more related to their actual standard of living, so it makes a greater contribution to income. We select different

independent variables for these two types of income to construct income-determining equations according to the previous literature.

Among them, the independent variables of wage income were divided into two categories. The residents' characteristics included age (18 to 65 years old), professional level, education level, whether they understand foreign languages, health status, etc. The other category was the resident's work background, including whether he has work experience, whether he is engaged in agricultural production activities, the type of employer, the type of work industry, social class, whether he has registered permanent residence, and his local adaptation situation. The independent variables of capital income were excluded from the independent variables of wage income, and relevant information, such as the industry and the type of employer, was removed. Table 1 reports the categories and specific definitions of variables:

Table 1. Variable classification and definition.

Category		Meaning	Variables	Total Number
Independent variables	Quantitative variables	Knowledge of foreign languages	X1	103
		Whether they have a professional qualification certificate	X2	
		Number of professional qualification certificates	X3	
		Number of local friends	X4	
		Local dialect level	X5	
		Social class	X6	
		Whether they are engaged in agricultural production	X7	
		Whether they have relocated the household registration	X8	
	Qualitative variables	Location	X9-X37	
		Education level	X38-X46	
		Political outlook	X47-X49	
		Health level	X50-X54	
		Father's education level	X55-X64	
		Mother's education level	X65-X72	
		Industry	X73-X89	
		Employer type	X90-X103	
Dependent variable	Quantitative variable	Wage income	Y1	2
		Capital income	Y2	

Table 2 reports the descriptive statistics of the variables:

Table 2. Statistical description of variables.

Variable Category	Meaning	Average Value	Maximum Value	Minimum Value
Quantitative variables	Knowledge of foreign languages	0.152	1	0
	Whether they have a professional qualification certificate	0.216	1	0
	Number of professional qualification certificates	0.789	18	0
	Number of local friends	0.075	1	0
	Local dialect level	0.066	1	0
	Social class	3.052	9	0
	Whether they are engaged in agricultural production	0.629	1	0
	Whether to relocate the household registration	0.370	1	0
	Wage income	10.291	12.900	3.689
	Capital income	10.365	13.304	3.689
Qualitative variables	Location	Shanghai, Yunnan, Region: Inner Mongolia, Beijing, Jilin, Sichuan, Tianjin, Ningxia, Anhui, Shandong, Shanxi, Guangdong, Guangxi, Xinjiang, Jiangsu, Jiangxi, Hebei, Henan, Zhejiang, Hubei, Hunan, Gansu, Fujian, Guizhou, Liaoning, Chongqing, Shaanxi, Qinghai, Heilongjiang		
	Education level	no school, elementary school, junior high school, technical secondary school, high school, junior college, undergraduate, master's, doctorate		
	Political outlook	the masses, democratic parties, members of the Communist Party of China		
	Health level	(not filled in), average, healthy, relatively unhealthy, very unhealthy, very healthy		
	Father's education level	(not filled in), never attended school, elementary school, junior high school, technical secondary school, high school, college, undergraduate, master's, doctorate, other		
	Mother's education level	(not filled in), never attended school, elementary school, junior high school, technical secondary school, high school, college, undergraduate, master's, doctorate, other		
	Industry	(not filled in), unclear, not applicable, transportation, storage, post and telecommunications, other industries, manufacturing, farming: agriculture, forestry, animal husbandry, sideline and fishery production (such as farming, breeding chickens, ducks, aquatic products, etc.), hygiene, sports and social welfare industry, state agencies, party and government agencies and social organizations, geological survey industry, water conservancy management industry, construction industry, real estate industry, wholesale and retail trade, catering industry, refusal to answer, education, culture and art, radio, film and television industry, electricity, gas and water production and supply industry, social service industry, scientific research and comprehensive technical service industry, extractive industry, finance and insurance industry		
	Employer type	(not filled in), unclear, not applicable, individual industrial and commercial, public institution, party and government organs, people's organization, army, others, farming: agriculture, forestry, animal husbandry, sideline fishery production (such as farming, breeding chickens, ducks, aquatic products, etc.), state-owned/collective institutions, state-owned enterprises, foreign investment, joint ventures, refusal to answer, autonomous organizations such as village neighborhood committees, private non-enterprises, social organizations and other social organizations, private and private enterprises, freelance workers (freelancers, casual workers, vendors, etc.), nanny without dispatch unit (self-operated driver, hand craftsman, etc.), collective enterprise		

Note: Except for the number of professional qualification certificates, social class, wage income, and capital income, other variables are all dummy variables.

The sample used in this study was obtained from the panel data of the China Labor force Dynamics Survey (CLDS) of Sun Yat-sen University. The China Labor Force Dynamics Survey (CLDS) established a comprehensive database with the labor force as the object of the investigation through a biennial follow-up survey of urban and rural villages in China, including labor force individuals and families. The three-level tracking and cross-sectional data of the community can provide high-quality basic data for empirically oriented theoretical research and policy research. The CLDS completed the 2012 national baseline and

follow-up surveys in 2014 and 2016. The CLDS targets the working-age population, aged 15–64, focusing on the status of and changes in labor force education, employment, labor rights, occupational mobility, occupational protection and health, occupational satisfaction, and happiness. At the same time, it investigates the political, economic, and social development of the communities where the labor force is located and the demographic structure of labor force households, family property and income, household consumption, family donations, rural household production, and land. In 2012, the CLDS completed the first national official survey involving 303 villages, 10,612 households, and 16,253 labor force individuals. In 2014, the CLDS completed the first follow-up survey, adding 101 community samples to the surveys of 2012, and completed 14,226 household and 23,594 individual questionnaires. In 2016, the third national CLDS survey involved replacing a quarter of the surveys from 2014 with community samples, and a total of 401 community questionnaires, 14,226 household questionnaires, and 21,086 individual questionnaires were completed. The success rate of all households registered in this survey round was 71.37%, and the completion rate of individual questionnaires within a family was 76.86%. In the follow-up survey samples, the success rate of family tracking was 71.99%, and the success rate of individual tracking was 58.40% [26].

The steps for selecting samples were as follows: First, to ensure the continuity of the research subjects, we selected individuals who had participated in the survey for all three years; secondly, since the old questionnaire ID was updated to the new ID in 2014, this article used the data from 2014 to conduct the individual matching. In the specific extraction process, the indicator name changed, and this article made corresponding adjustments and finally obtained a balanced sample of 4,091 individuals and 12,273 observations. Next, this study took the natural logarithms of wage income and capital income. Using the quantitative independent variables, in order to eliminate the influence of data dimensions and speed up the regression speed, a linear normalization operation was adopted:

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)}$$

We split qualitative variables into multiple dummy variables to facilitate subsequent regression. In addition, we deleted all observations with zero income, missing values, and incomes from the highest 1% of the year to avoid interference from extreme values effecting the forecast results.

4. Results

Next, we established a regression model on the reduced dimensionality data to study the determinants of residents' wage income and capital income. In order to ensure the accuracy and robustness of the regression results, this study divided the CLDS data into two parts: a training set and a test set. Data from 2012 and 2014 were used as the training set, and data from 2016 formed the test set. In this section, we used stepwise regression and partial least squares to analyze the training set.

4.1. Dimensionality Reduction Result

This study used the Lasso algorithm with the R to perform a preliminary dimensionality reduction on the data. Moreover, it uses LARS (Least Angle Regression) minimum angle regression to find the step that satisfies the optimal regression coefficient on the solution path, which minimizes the mean square error MSE count to filter the variables. The number of independent variables after dimensionality reduction is shown in the following table (Table 3):

Table 3. Dimensionality reduction results.

Y	Lasso Dimensionality Reduction	
	Number of Original Independent Variables	Number of Remaining Independent Variables
Wage income	103	49
Capital income	72	33

After dimensionality reduction, the original 103 independent variables of wage income were effectively reduced to 49, and the original 72 independent variables of capital income were reduced to 33. The specific dimensionality reduction results are shown in the following table (Table 4):

Table 4. Specific description of dimensionality reduction results.

Dependent Variables	Extract Variables after Dimensionality Reduction
Wage income	X1 (whether they understand a foreign language), X2 (whether they have a professional qualification certificate), X4 (number of local friends), X5 (level of local dialect), X7 (whether engaged in agricultural production), X9 (whether they live in Shanghai), X12 (whether they live in Beijing), X13 (whether they live in Jilin), X15 (whether they live in Tianjin), X17 (whether they live in Anhui), X18 (whether they live in Shandong), X22 (whether they live in Xinjiang), X23 (whether they live in Jiangsu), X24 (whether they live in Jiangxi), X25 (whether they live in Hebei), X26 (whether they live in Henan), X27 (whether they live in Zhejiang), X29 (whether they live in Hunan), X31 (whether they live in Fujian), X34 (whether they live in Chongqing), X38 (whether education level is technical secondary school?), X40 (whether education level is a doctorate?), X41 (whether education level is junior college), X42 (whether education level is primary school), X43 (whether education level is never attended school), X44 (whether education level is undergraduate), X50 (whether health level is average), X52 (whether health level is relatively unhealthy), X54 (whether health level is very healthy), X56 (whether father's education level is other), X57 (whether father's education level is junior high school), X59 (whether father's education level is a junior college), X61 (whether father's education level is never attended school), X62 (whether father's education level is a bachelor's degree), X76 (whether the industry is farming: agriculture, forestry, animal husbandry, sideline fishery production (such as farming, breeding chickens, ducks, aquatic products, etc.)), X80 (whether the industry is a construction industry), X83 (whether the industry is refusal to answer), X85 (whether the industry is the production and supply of electricity, gas and water), X86 (whether the industry is a social service industry), X87 (whether the industry is scientific research and comprehensive technical service industry), X89 (whether the industry is financial and insurance), X91 (whether employer is a public institution), X94 (whether employer is agriculture, forestry, animal husbandry, sideline and fishery production), X95 (whether employer is a state-owned/collective institution), X96 (whether employer is a state-owned enterprise), X100 (whether employer is a private non-enterprise, a social organization, etc.), X101 (whether employer is a private or private enterprise), X102 (whether employer type is freelance workers (freelancers, casual workers, vendors, babysitters without dispatch units, self-operated drivers, manual craftsmen, etc.)), X103 (whether employer is a collective enterprise)
Capital income	X1 (whether they understand a foreign language), X2 (whether they have a professional qualification certificate), X5 (level of local dialect), X7 (whether engaged in agricultural production), X10 (whether they live in Yunnan), X14 (whether they live in), X15 (whether they live in Tianjin), X16 (whether they live in Ningxia), X17 (whether they live in Anhui), X18 (whether they live in Shandong), X19 (whether they live in is it Shanxi), X20 (whether they live in Guangdong), X21 (whether they live in Guangxi), X23 (whether they live in Jiangsu), X24 (whether they live in Jiangxi), X27 (whether they live in Zhejiang), X30 (whether they live in Gansu), X31 (whether they live in Fujian), X32 (whether they live in Guizhou), X35 (whether they live in Shaanxi), X36 (whether they live in Qinghai), X42 (whether education level is elementary school), X43 (whether education level is undergraduate), X44 (whether education level is undergraduate), X45 (whether education level is master's), X46 (whether education level is high school), X49 (whether political outlook is the masses), X50 (whether health level is average), X52 (whether health level is relatively unhealthy), X53 (whether health level is very unhealthy), X54 (whether health level is very healthy), X58 (whether father's education level is PhD), X59 (whether father's education level is junior high school), X61 (whether father's education level is no school), X64 (whether father's education level is high school), X67 (whether mother's education level is junior high school), X68 (whether mother's education level is college), X72 (whether mother's education level is high school)

4.2. Implementation Process and Regression Results

This study used the step function in the R software (Auckland, New Zealand) to implement the stepwise regression method and used the PLSR library to implement the partial least square method. The compilation environment is R version 3.5.0 (RStudio Version 1.1.419). The regression equation was established as follows:

$$y_g = \gamma_0 + \gamma_1 x_1 + \gamma_2 x_2 + \cdots + \gamma_i x_i + \varepsilon_g$$

Among the variables, y_g is wage income, x_i is the independent variable of wage income, and i is the number of independent variables.

$$y_z = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \cdots + \beta_m z_m + \varepsilon_z$$

Among these variables, y_z is capital income, z_m is the independent variable of capital income, and m is the number of independent variables.

4.2.1. Stepwise Regression Method Results

The stepwise regression method can select a variable adjustment scheme corresponding to the smallest AIC value by observing the change in AIC after a certain variable is deleted. The specific results are detailed below.

It can be seen in Table 5 that after the application of the stepwise regression method, the number of independent variables of wage income dropped from 49 to 29, while the number of independent variables of capital income dropped from 33 to 25; the effect of dimensionality reduction was better. The regression results are as follows (Table 5):

Table 5. Stepwise regression method variable selection.

	Stepwise Regression	
	Number of Original Independent Variables	**Number of Current Independent Variables**
Wage income	49	29
Capital income	33	25

The overall *p*-value of the wage income model is less than 0.01, and the fitting effect is good. From the perspective of human capital, X2 (whether they have a professional qualification certificate), X5 (local dialect level), X42 (whether education level is elementary school), X43 (the coefficient of the variable X44 (whether the education level is an undergraduate)) are the most significant. The coefficients of the independent variables of X2, X5, and X44 are positive, while the coefficients of X42 and X43 are negative. This shows that, given other factors remain unchanged, the number of professional qualification certificates and a high level of local dialect education have a greater degree of positive impact on wage income. In comparison, few academic qualifications has a greater degree of negative impact on wage income.

Individuals who have a large number of professional qualifications and proficiency in various vocational skills, along with a high level of education, tend to have higher wage incomes. This phenomenon reflects the growing demand for high-quality talent in the job market. Additionally, the regional characteristics of China's multi-dialect system may play a role in determining the incomes of individuals. People who are proficient in their local dialects tend to be more favored in the job market, which makes it easier for them to obtain higher wage incomes. In conclusion, holding professional qualifications, having strong communication skills, and having a good level of education are important factors in determining an individual's wage income in China.

The overall *p*-value of the capital income model is less than 0.01, and the fitting effect is good; among them, the coefficients of the variables X7 (whether engaged in agricultural production), X42 (whether education level is elementary school), and X43 (whether education level is never attended school) are the most significant. Moreover, these are all negative. This shows that low education levels and engaging in agriculture have a greater degree of negative impact on capital income. Those with low education levels and agricultural practitioners have lower incomes.

4.2.2. Partial Least Squares Regression Results

The partial least squares method can manually select variables by observing the contribution rate of principal components to each variable. However, from a data point of

view, due to the small difference in the contribution rates of the components of the partial least squares method, this paper did not further extract variables. The regression results are detailed below.

The overall *p*-value of the wage income model is less than 0.01, and the fitting effect is good; among them, the coefficients of the variables X2 (whether they have a professional qualification certificate), X42 (whether education level is elementary school), and X44 (whether education level is undergraduate) are the most significant. Among these, the coefficients of X2 and X44 are positive, and the coefficients of X42 are negative. This shows that holding many professional qualification certificates and having a high level of education can help individuals obtain a higher wage income.

The overall *p*-value of the capital income model is less than 0.01, and the fitting effect is good; the coefficients of the variables X42 (whether education level is elementary school), X43 (whether education level is no school), X50 (whether health level is average), X52 (level of health) are the most significant, and all are negative. This shows that low education and poor health have a relatively high degree of negative impact on the capital incomes of residents. This shows that society needs more healthy workers with high education who can obtain high capital incomes.

Combining the results of the two regression methods, we find that having a large number of professional qualification certificates, a high level of local dialect, and a high level of education helps residents obtain higher wage incomes. Meanwhile, residents with poor health and a low education level have lower capital incomes.

The regression results show that society has a higher demand for workers with high education levels, high professional skills, and good health, reflecting the importance of human capital. There is a certain gap in the rate of return between capital income and wage income, which needs to be adjusted.

4.3. Comparative Analysis of the Prediction Capabilities of the Two Regression Methods

In order to better observe the prediction effects of the regression models, we made a prediction for the 2016 data and compared it with the test set; that is, the 2016 CLDS data. The prediction results and comparison chart are detailed below.

#### 4.3.1. Stepwise Regression Method to Predict Results

According to Figures 1–4, the stepwise regression method and the partial least squares method have a good degree of prediction for wage income and capital income. In addition, Table 6 reports the amount of error of the two regression methods:

Table 6. Error comparison table of stepwise regression method and partial least square method.

| Method	Dependent Variable	Data Set	MAD	MSE	MAPE
Stepwise regression method	Wage income	Training set	0.275988	0.583369	0.062372
		Test set	0.288995	0.770744	0.076404
	Capital income	Training set	0.373707	0.973191	0.084687
		Test set	0.401561	0.963245	0.089789
Partial least square method	Wage income	Training set	0.267251	0.574956	0.061624
		Test set	0.28743	0.769891	0.076593
	Capital income	Training set	0.387758	1.020318	0.086448
		Test set	0.390108	0.924637	0.088307
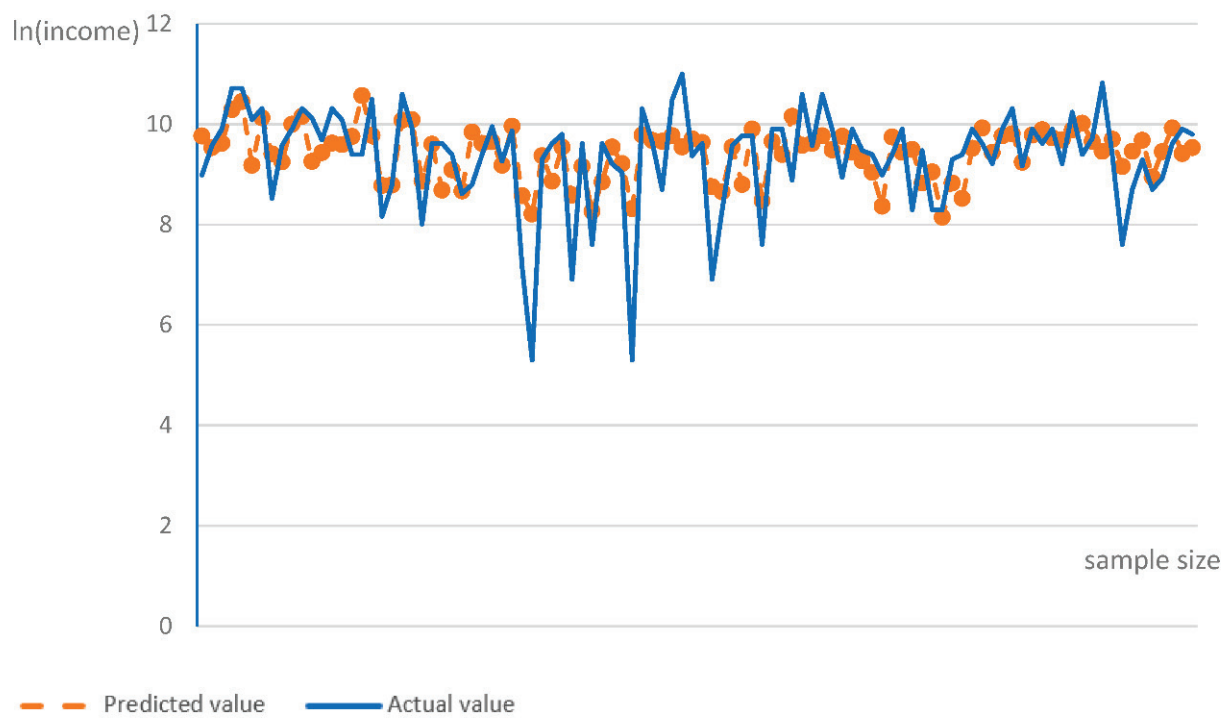
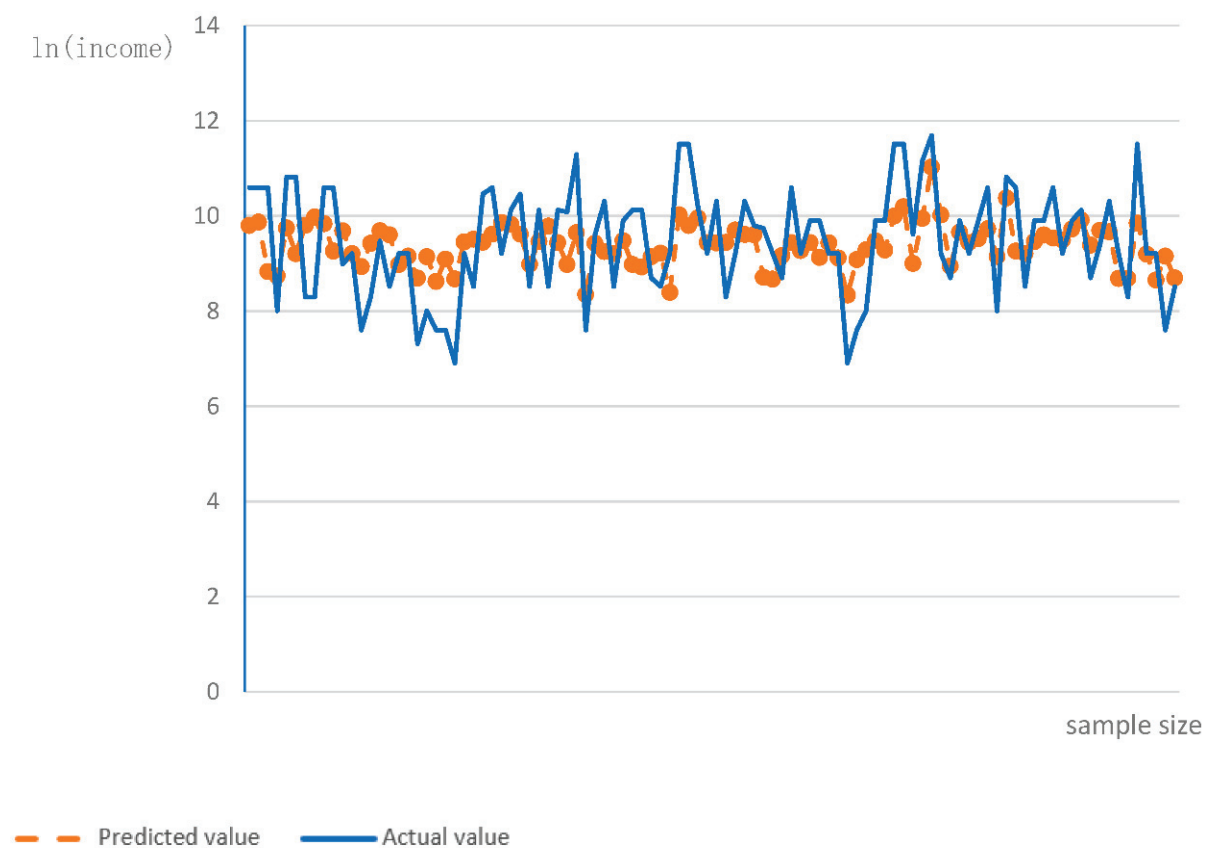**Figure 1.** Wage income forecast via stepwise regression vs. actual value comparison chart.
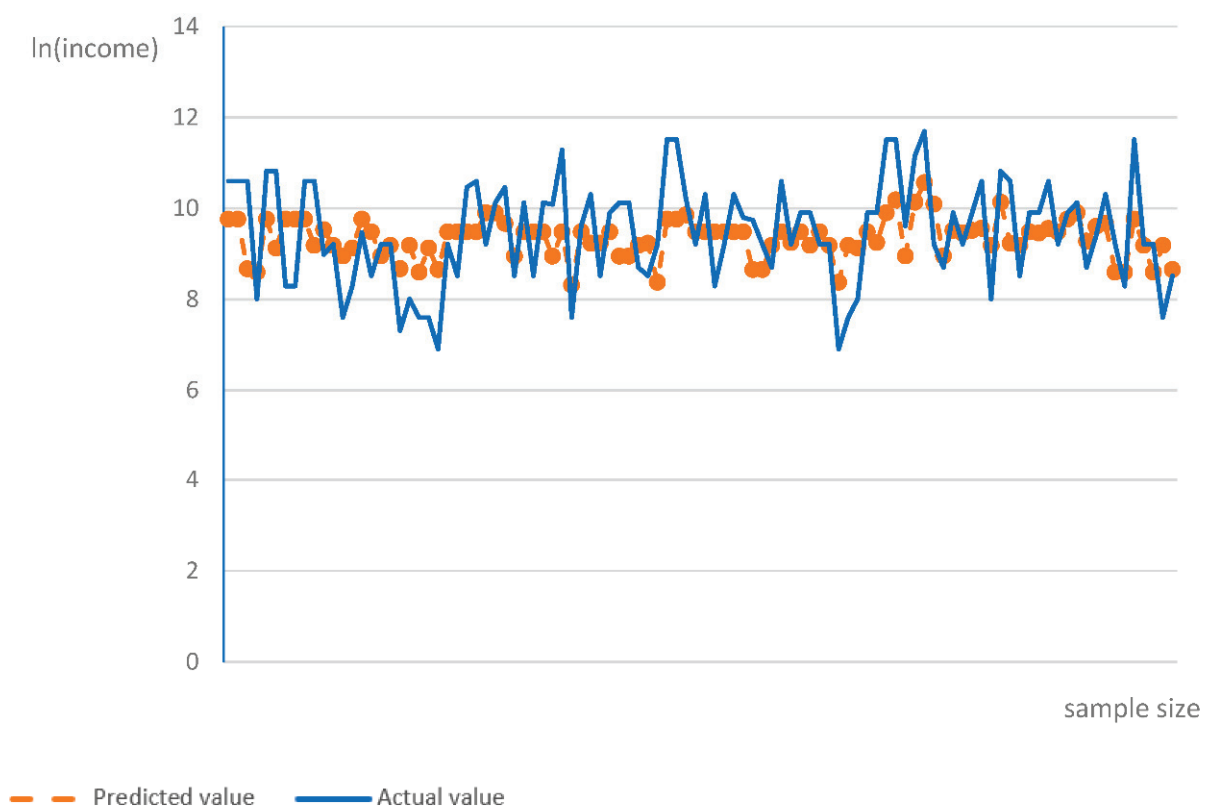
Figure 2. Capital income forecast via stepwise regression vs. actual value comparison chart.
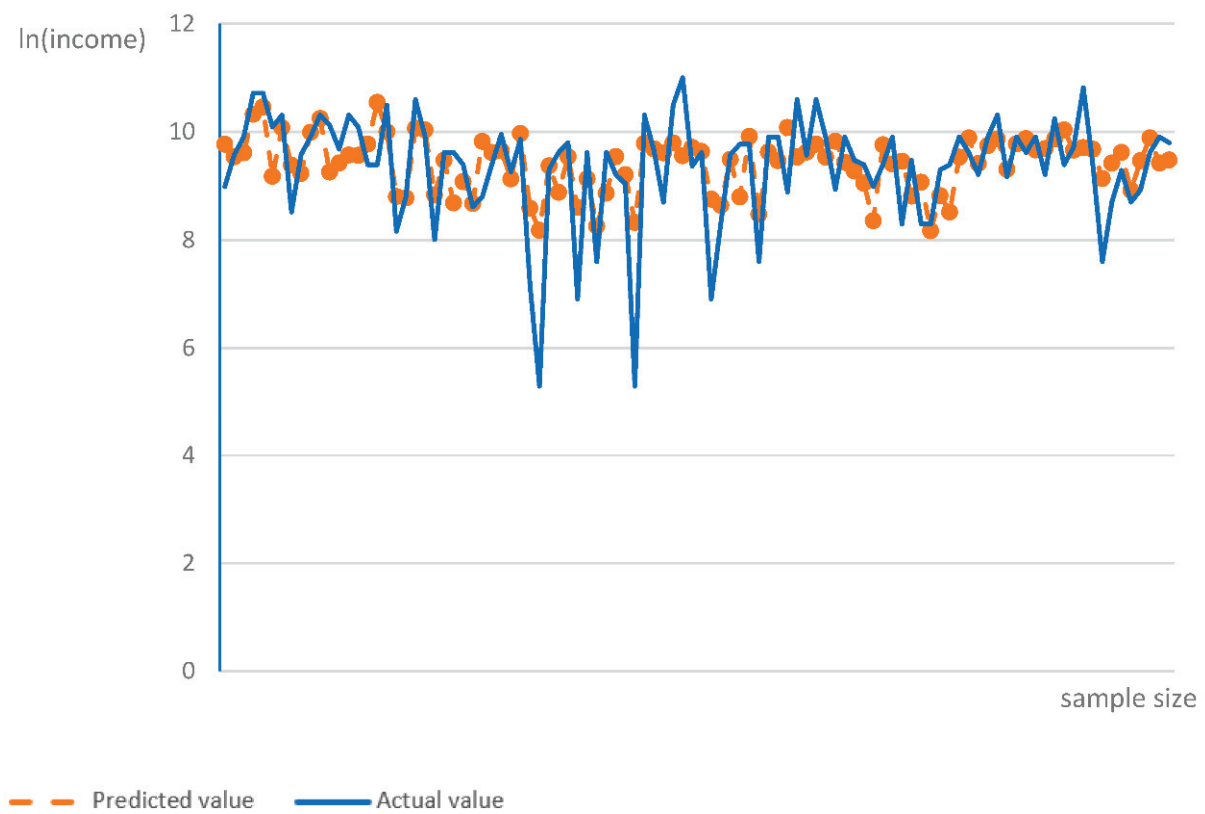
Figure 3. Wage income forecast by partial least square method vs. actual value comparison chart.

Figure 4. Capital income forecast via partial least squares method vs. actual value comparison chart.

4.3.2. Partial Least Squares Prediction Result

MAD (Median Absolute Deviation) refers to the median of the absolute value of the residual median deviation. In statistics, MAD is a measure of statistical dispersion, and it is a robust measure of the variability of a univariate sample of quantitative data.

$$MAD = median(|X_i - median(X)|)$$

where X_i is the ith value in the dataset and $median(X)$ is the median value in the dataset.

MSE (Mean Squared Error) refers to the mean value of the sum of squared errors of the predicted data and the corresponding points of the original data.

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y})^2$$

where n is the sample size of the dataset, y_i is the ith actual value in the dataset, and $\hat{y}$ is the prediction value in the dataset.

MAPE (Mean Absolute Percentage Error) refers to the average of the absolute value of the relative percentage error.

$$MAPE = \frac{1}{n} \sum_{i=1}^{n} \frac{(y_i - \hat{y}_i)}{y_i}$$

It can be seen from Table 5 that the error index values of the two methods are small, the values are less than 1 or close to 1, and the differences are within 0.2. Therefore, both the stepwise regression method and the partial least squares method can be used to obtain reasonable income forecasts.

5. Conclusions and Policy Recommendations

Constructing a scientific and practical talent development system is an important driving force for promoting the development of an innovative society. Over the past 40 years, China's economic growth has created a miracle that has attracted worldwide attention. However, with the gradual disappearance of the demographic dividend, a more scientific talent development system has been built to increase the human capital stock affecting the entire society and increase residents' income, as well as narrow the gap between regions and industries. This is imperative. This also has reference value for other developing countries.

This article explains the essential human capital characteristics affecting wage and capital income. Research on Chinese labor force dynamics survey data through statistical methods such as Lasso dimensionality reduction, stepwise regression, and the partial least squares method found that society has a high level of education and high education. In today's fast-paced and highly competitive job market, there is a growing demand for individuals who possess a unique combination of professional skills, good health, and strong communication abilities. These qualities are seen as critical in many industries, and they are valued by employers as they help increase productivity and performance. As a result, individuals who possess these human capital characteristics are more likely to find high-paying job opportunities and achieve greater financial success. Moreover, the development of these human capital traits can have a lasting impact on an individual's career and earning potential. A strong foundation of professional skills can help individuals stay ahead in their field and remain competitive, while good health and strong communication abilities can help them maintain positive relationships with coworkers and clients. These traits are highly sought after by employers, and individuals who possess them are more likely to earn higher salaries, receive promotions, and advance in their careers. Therefore, it is crucial for individuals to invest in their human capital and cultivate these important traits. This can be achieved through education, training, and personal development, and it can help individuals achieve greater financial success and stability in their careers. By

focusing on developing their human capital, individuals can take control of their future and maximize their earning potential in the job market. This verifies the research conducted by Mincer [27]. At the same time, in China, there is a significant difference between the rate of return on capital income and the rate of return on wage income. The rate of return on capital income is significantly higher than that of wage income; differences in industries and regions also significantly affect wage and capital income. Compared with traditional industries, high-tech industries have higher wage incomes. These facts show that we need an excellent talent development system to increase residents' incomes while narrowing the income gap between regions and industries to balance the rate of return on wage income and capital income as much as possible [28–30].

Therefore, the government must pay attention to the role of human capital and build a good talent development system. The Chinese government is also attaching more and more importance to vocational education and human capital development and put forward the document *Opinions on Deepening the Reform of Modern Vocational Education System Construction* in 2022.

Therefore, we put forward the following suggestions. First, the government should increase public education investment in the whole of society and improve vocational skills training to develop the core competitiveness of residents at work and the accumulation of human capital across the whole of society. It should also increase residents' human capital by subsidizing vocational education and enlarging public education expenditures to match talent development within the social scope with social needs. Second, we must focus on developing high-tech industries and introducing more workers from traditional industries into high-tech industries. The technology industry, through inter-industry mobility, can increase residents' wage income and narrow the income gap between industries. Moreover, through the support of high-tech industries, more workers will be guided to move among them, by which means residents' income and national economic competitiveness can be increased. Third, the government should also strengthen the promotion of common language, reduce transaction costs caused by communication and communication barriers, and reduce communication barriers caused by dialects as much as possible. Because of this, it is difficult for individuals to utilize their human capital, hindering talent development fully. Fourth, the government should establish a sound worker flow system, promote inter-regional population mobility, introduce more high-quality workers from outside, improve overall economic competitiveness in competition and communication between workers, and reduce the inter-regional income gap through this system.

The aim of this article was to evaluate the impact of income factors using statistical methods such as Lasso dimensionality reduction, stepwise regression, and partial least squares. The 2016 data was used as a test set and the results showed a good fit with the actual data, suggesting that the introduction of this method could enhance the empirical methods in this field. Furthermore, the article also compares the impact of capital income based on prior research and provides relevant policy recommendations for the talent development system, thereby enriching the research outcomes in this field.

In addition, this article introduces the use of machine learning techniques based on micro-data to verify and strengthen the impact of traditional human capital on income, and offers insightful policy recommendations for China's current situation. However, further research is still needed to optimize the talent development system and to understand the impact of the rapid development of the internet on the structure of human capital in the new era.

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How Doctoral Students Understand Academic Identity in China: A Qualitative Study Based on the Grounded Theory

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Abstract: The process of doctoral students transitioning from being knowledge learners to being knowledge researchers is beneficial for personal growth and career development. This study explores how doctoral students at Chinese research universities understand academic identity from a psychological perspective based on grounded theory. Understanding academic identity for doctoral students involves three psychological activities: situation recognition, psychological interaction, and reflective positioning. The sense of academic meaning and the sense of academic efficacy shape doctoral students' understanding of academic identity, resulting in four patterns: Adeptness, Academic Pursuit, Alienation and Powerlessness, and Struggling for Meaning. Academic meaning serves as the internal driving force for developing academic identity, while academic efficacy acts as a psychological condition for maintaining academic identity. Therefore, it is crucial to enhance doctoral students' recognition of academic meaning and academic efficacy.

Keywords: doctoral students; academic identity; academic meaning; academic efficacy

1. Introduction

The experiences and professional socialization of doctoral students have long been regarded as a black box [1]. In China, doctoral students assume multiple roles. On the one hand, they are regarded as learners with sufficient knowledge and skills. Through rigorous academic training, they have been capable of professional knowledge and enhanced research abilities, all with the main aim of cultivating innovation capability. Doctoral students are also treated by universities as regular recipients of education [2]. On the other hand, doctoral students are also junior researchers. With the advent of the knowledge economy, universities are playing a strategic role in enabling innovation and economic growth, and graduate education programs are the key to long-term growth and the future of the innovation economy, with doctoral students serving as knowledge workers [3]. Doctoral education not only forms a part of the education system, but also serves as a vital component of the knowledge production system [4]. The training of doctoral students has been closely combined with research, making it the main procedure of doctoral education [5]. Doctoral students are not only recipients of information, but also producers of knowledge.

The role of a doctoral student can be seen as a transitional role between undergraduate and faculty status [6]. Within doctoral programs, the simultaneous presence of multiple roles can easily cause ambiguity and confusion regarding doctoral students' self-positioning. Higher education institutions require doctoral students to engage in academic activities, while simultaneously treating them as managed students, creating potential confusion about their self-identity [7]. Doctoral studies require entering the academic community as a contributing researcher, a transition that often poses challenges for many prospective doctoral students [8]. Failure to recognize their role as researchers and establish a research

identity may negatively impact individual development, leading to frustration, disappointment, lack of self-confidence, and other problems during their doctoral journey [9]. This can result in a deficiency in the attitude required for scientific research and may lead to inappropriate ways to participate in academic competition [7]. The failure of identity formation is related to the attrition of doctoral programs [10], and will cause difficulties and challenges in the socialization of doctoral students [11]. In the context of doctoral writing, identity development primarily involves learning how to communicate within the discipline and situating one's work within the larger field [12]. The establishment of a research identity upon entering a doctoral program can significantly influence their academic performance during their doctoral studies [13]. For doctoral students pursuing careers in academia, failure to establish an identity as researchers may affect their career development in the academic field after graduation.

Academic identity refers to an individual's identification as a member socialized into the values, norms, practices, and belief systems of their particular epistemic community and disciplinary culture [14]. For doctoral students, this entails defining themselves as academic researchers. Although doctoral education cannot facilitate identity transformation for all doctoral students, successfully constructing an academic identity is important for the personal growth and future careers of PhD recipients. However, within doctoral programs, many students are in the process of transitioning from being learners of knowledge to independent researchers. Their individual differences in cognitive development, skill enhancement, and integration into the community lead to variations in their perceptions of academic identity. This study utilizes grounded theory to explore the process of understanding the academic identity of doctoral students at Chinese universities, aiming to reveal how doctoral students become researchers through academic training.

2. Literature Review

Academic identity is an ambiguous term within the literature and seems to appear most commonly as referring to research work and positioning. Other phrases including "professional identity", "scholarly identity", "researcher identity", and "disciplinary identity" also refer to how researchers position themselves within their particular fields and exhibit skills and thinking [12,15] which are often used interchangeably. Identity is shaped by the interplay between micro-level individuals and the larger and macro-level contexts within which they exist [16]. Academic identity, built upon this foundation of personal identity, incorporates both the professional role within academia and the broader social identity within the academic community [17]. The discipline and academic freedom, which are in many cases the sources of meaning and self-esteem, as well as being what is most valued, emerge as most important for academic identities [18]. Academic identity is regarded as the definition that broadly conceptualizes the construct in terms of beliefs, attitudes, and efficacy related to scholarly research [19], and often appears in the literature on doctoral students as a key outcome of graduate education [20]. For doctoral students, who are involved in an ambiguous and confusing complex roles, such as students, researchers, teachers, and departmental members [6], academic identity entails both skill and independence, demonstrated through how one reads, writes, speaks, and acts [12]. From the perspective of Sweitzer, doctoral students' professional identity is related to their perceptions about and development of the three key roles of doctoral student, research assistant, and teacher [21]. Choi et al. regarded professional identity as an individual's felt and recognized association with a vocation requiring specialized knowledge and skills and pertinent values, activities and norms, and they then defined identity as scholar as a specific type of professional identity and as an individual's felt or recognized association with communities doing scholarship pertaining to an academic discipline in doctoral programs [22].

As identities are not fixed but fluid and continuously constructed, co-constructed, and reconstructed over time [23], academic identity is not stable with clear-cut boundaries; instead, it is constantly rebuilt, reshaped and renegotiated in social interaction [14]. The development of a researcher requires doctoral students to internalize their identification

with and commitment to the professional role [24]. Ulriksen et al. recognized identity as always being embedded in culture, and newcomers had to understand the social and cultural setting which they entered and relate that to their identity [25]. Several studies have described the process of constructing a doctoral academic identity by exploring the different stages of socialization [20,26], which equates identity development with the process of socialization. As indicated by socialization models, independent academic identities are pursued only after the socialization of doctoral students and do not emerge during progression toward professionalism [27]. Other studies regard the construction of academic identity as an iterative process shaped primarily by social structures and interaction [12,28]. For example, Jazvac-Martek found that construction, development, or changes to academic identity were interactive, based on continuous reflexive dialogue and relations with significant others, and remained a dialogic process throughout the doctorate [29].

Previous studies have explored the factors influencing the academic identity of doctoral students. Several scholars emphasized the crucial role of supervisors (advisors, mentors) as interactive partners in the construction of doctoral students' academic identity. Weiss suggested that the frequency and nature of contact with faculty members were significantly related to the amount of professional role commitment [30]. Curtin et al. found that advisor support was associated with a stronger sense of belonging and academic self-concept for doctoral students [31]. The informal peer group was also an interacting group that created the potential for change in or development of students' identification [32]. Foot et al. highlighted the importance of students undertaking self-reflection and dialogue with peers and suggested that peers could provide support to each other through socialization and identity transition [33]. In addition, disciplines and institutions provide environments that influence doctoral students' academic identity [34–36], from which students experience a sense of belonging to a collective community. Smith and Hatmaker developed a multi-level model of the organizational, relational, and individual level tactics through which doctoral students learned to become researchers, and offered insight into the students' own proactivity [37]. The socialization model emphasizes knowledge acquisition, investment, and involvement as the core elements to promote the role identity of graduate students [27].

The recognition and development of academic identity is an important aspect of doctoral education [38]. Generally, previous studies have focused on exploring doctoral students' academic identity from external environments, while paying less attention to the psychological mechanisms of academic identity. Therefore, to further uncover the black box of doctoral students' identity construction, it is necessary to explore how Chinese doctoral students understand academic identity at the psychological level.

3. Methodology and Data

This study adopted the grounded theory as the research method to explore how doctoral students develop an academic identity. Grounded theory, as a qualitative research approach, is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to the phenomenon [39] (p. 23). It provides researchers with a framework to generate a theory from the context of a phenomenon and offers a process to develop a model to be used as a theoretical foundation [40]. This study collected and analyzed data using the grounded theory proposed by Strauss and Corbin, referencing Chen and Wang's coding method in practice [41]. Pre-existing studies on the construction of doctoral students' academic identity have yet to establish a universally accepted and definitive analytical framework. The process of identity construction is iterative, unstable, and diverse for doctoral students, making it challenging to describe in a uniform manner. Grounded theory assists in generating a theory from the data that can illuminate the phenomena of academic identity construction among doctoral students, and also provides this study with a robust analytical tool to explore the characteristics manifested by doctoral students as a group.

3.1. Data Collection

This study collected data through semi-structured individual interviews. When selecting participants who could provide the maximum amount of information for the research question, factors such as doctoral stage, gender, discipline, and institution were considered. Multiple interviews were conducted with 21 doctoral students from research universities (see Appendix A). The semi-structured interviews consisted of nine open-ended questions asked in sequential order; these questions were developed based on the literature. Examples of the questions included the following: (1) How would you describe your identities? (2) Describe what happened when you thought of yourself as a researcher, and (3) talk about what helped you form an academic identity and the experiences that created doubts or hesitations about becoming a researcher. The participants were from three Chinese research universities and included 11 males and 10 females, with 4 from natural science, 6 from engineering, 4 from humanities, and 7 from social science. The interviews, which lasted approximately 60–120 minutes, were audio recorded. After all the interviews were conducted, a member of the research team transcribed and translated them into English. Memos were written throughout the research process to document theoretical ideas.

3.2. Data Analysis

This study adhered to the grounded theory data analysis procedures outlined by Strauss and Corbin [39], which proceed in three coding steps: open coding, axial coding, and selective coding.

For a grounded theory study, data analysis begins with the open coding of transcripts. In this stage, we suspended all preconceived notions and analyzed the data in an open and theoretically sensitive manner. Careful reading and deconstruction of the interview transcripts, notes, and memos revealed key concepts and allowed us to establish labels. Through this process, we identified seven categories. These categories, including their properties and dimensions, are conceptualized in Table 1.

Table 1. Results of the open coding.

Categories	Properties	Dimensions
Becoming "doctoral student"	Role transition	Learner—researcher
	Action transition	Learning knowledge—learning how to conduct research—producing knowledge
	Relational transition	Dependence—independence
Perceiving "doctoral student"	Perceiving roles	Roles in reality, symbolic role
	Perceiving tasks	Knowledge production tasks, course learning tasks, knowledge dissemination tasks, administrative management tasks, project execution tasks
	Perceiving academic profession	Career choice possibilities, academic career content, academic career benefits, academic career challenges
	Perceiving self	Efforts for the degree, doctoral life status
Evaluating "doctoral student"	Evaluating academia	Instrumental evaluation—intrinsic evaluation
	Evaluating self	Academic-self fitting, academic agency
Feeling "doctoral student"	Sense of academic meaning	Realistic transformation effect, affirmation from others, achievement of preferences, self-identification
	Sense of academic efficacy	Cognition of academic talent, cognition of academic ability, evaluation of significant others, evaluation of self-involvement
	Mental pressure	Pressure of completion, pressure of academic pursuit, pressure of academic career, pressure of non-academic infringement, pressure of physical overload
	Academic pleasure	The joy of knowledge exploration, the joy of discovering results, the joy of interpersonal interaction

Table 1. *Cont.*

Categories	Properties	Dimensions
Reflecting "who I am"	Position of academic identity	"I am a researcher", "I am an immature researcher", "I might be a researcher in the future", "I am not yet a researcher", "I am not a researcher"
Context of academic identity	Academic life rehearsal	Participation in research, academic exchanges, teaching practices
	Stepping out of the ivory tower	Life beyond academia, social interpersonal communication
Interaction of academic identity	Demonstration Incentives Integration	Positive demonstration—negative demonstration Positive incentives—negative incentives Strong self-consciousness—weak self-consciousness

Axial coding is a set of procedures in which data are reassembled in new ways after open coding, by making connections between categories. This is performed by utilizing a coding paradigm involving conditions, context, action/interactional strategies, and consequences [39] (p. 96). Based on this paradigm model, as shown in Table 2, this study gathered the scattered categories generated by open coding, reorganized and conceptualized data around the central phenomenon, and established initial associations between categories and their properties.

Table 2. Results of the axial coding.

Paradigm	Categories
Causal conditions	Role transition, action transition, relational transition
Phenomenon	Becoming "doctoral student"
Context	Academic life rehearsal, stepping out of the ivory tower
Intervening conditions	Interaction of academic identity
Action/Interaction	Perceiving "doctoral student", Evaluating "doctoral student", Feeling "doctoral student"
Consequences	Reflecting "who I am"

Selective coding is the process of identifying the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development [39] (p. 116). Selective coding involves clarifying the core category that integrates other categories through explicating the story line to generate a grounded theory. In this study, after conceptualizing the research topic through the story line, the core category "Doctoral students' understanding of academic identity" was determined based on theoretical sensitivity. "Sense of academic meaning" and "sense of academic efficacy" were identified as two properties of the core category. As illustrated in Table 3, guided by these properties, the core category was divided into four patterns: Adeptness, Academic Pursuit, Alienation and Powerlessness, and Struggling for Meaning.

Table 3. Patterns of selective coding.

Sense of Academic Meaning \ Sense of Academic Efficacy	High	Low
Strong	Adeptness	Academic Pursuit
Weak	Struggling for Meaning	Alienation and Powerlessness

These four patterns represent diverse types of student understanding the academic identity. "Adeptness" characterizes doctoral students who have a strong sense of academic meaning and efficacy, generally positioning themselves within or near the academic community. "Academic Pursuit" applies to doctoral students with strong academic meaning

but low efficacy; they usually position themselves on the periphery of the academic community. "Alienation and Powerlessness" refers to individuals with a low sense of both academic meaning and efficacy, who often feel alienated and incompetent. "Struggling for Meaning" describes doctoral students who have a weak sense of meaning but a strong sense of efficacy, frequently encountering conflicts and internal struggles about meaning.

Finally, after validating these relationships against the data, it appeared that this study achieved theoretical saturation. Therefore, the grounded theory generated in this study is that the extent to which doctoral students perceive a sense of academic meaning and efficacy influences their understanding of academic identity.

The primary researchers for this study were former doctoral students, with divergent perspectives on academic culture, ranging from viewing it as a noble pursuit to merely a means of livelihood. Due to the diversity of researchers' personal positions, this study performed the data analysis with reflexivity and collaboration. Recognizing the varied backgrounds and viewpoints of the researchers, the analysis was conducted with a critical eye, acknowledging individual biases. Meanwhile, researchers strived to adopt the perspectives of the participants during data analysis, extrapolating their view and methods of constructing meanings from their words and actions, thereby ensuring that the researcher's interpretation was as close to reality as possible. To ensure the trustworthiness of the findings, peer debriefing and member checking sessions were undertaken, with preliminary interpretations presented to academic supervisors and fellow doctoral students. This collaborative process facilitated rigorous scrutiny of the interpretations and enriched the analysis, ultimately enhancing the credibility of this qualitative research.

In this study, to thoroughly present the grounded theory generated by the data, we first describe the psychological process by which doctoral students understand their academic identity. We then analyze the various patterns of this understanding and discuss the reasons for differences in Chinese doctoral students' understanding of academic identity.

4. Psychological Processes of Doctoral Students' Understanding Academic Identity

The understanding of academic identity by doctoral students is a process in which they perceive, evaluate, feel, and reflect upon their academic selves in their academic situation and interactions. This process encompasses three psychological operations: situation recognition, psychological interaction, and reflective positioning.

4.1. Situation Recognition

Situation recognition is the initial step in doctoral students' understanding of academic identity. They recognize role transition, action transition, and relational transition in current academic situations.

In terms of their roles, doctoral students believe that they must fulfill the dual role expectations of being a learner and a researcher, and that they need to transition from being a learner to being a researcher. As NS-10 (Chemistry, male) describes, "Pursuing a PhD degree is a processing phase: it transforms you from an undergraduate to a highly mature researcher". Only after experiencing those role transitions can doctoral students achieve a sense of identity as researchers. EN-20 (Computer Science, male) states, "When I just started my program, I still saw myself as a student, and felt the need to understand and learn about my chosen field. However, midway through my research, my role shifted to a researcher".

In regard to the action transitions associated with situation recognition, doctoral students perceive a shift in their primary task: moving from acquiring knowledge and skills, to producing knowledge. In the early stages of their doctoral training, students are required to complete a rigorous course load and establish the foundational knowledge necessary for their research. As NS-1 (Physics, male) notes, "The breadth and depth of knowledge can greatly promote research work". The process of learning how to produce knowledge signifies a transitional stage for doctoral students, one that sees them moving from a pure learning phase to a phase of knowledge production. This transition necessitates

that doctoral students not only master professional knowledge, but also learn how to apply this knowledge, understand research paradigms, and develop research abilities. Being directly involved in knowledge production represents a crowning task for doctoral students, where their educational and research experiences converge. As NS-10 (Chemistry, male) realizes, "My research life is essentially synonymous with my life as a doctoral student".

In terms of interpersonal relationships within the academic situation, doctoral students perceive a transition from dependence to independence, particularly in their relationships with academic support groups, especially their supervisors. At the early stages of the program, doctoral students rely heavily on their supervisors. This is noted by EN-7 (Computer Science, male) who observes, "As a novice in the field, I still need guidance". Meanwhile, EN-9 (Engineering, female) attributes a loss of academic interest to the lack of early guidance from a supervisor, stating, "A master leads the way, and apprentices cultivate themselves. But I never had anyone guide me in research, and as a result, pursuing a PhD was exhausting. For me, the research was not going well, and eventually, I no longer enjoyed it". Doctoral students realize they have to transition from relying on their academic support group to being able to conduct research independently. As SS-4 (Education, female) states, "Getting a PhD is indeed different from earning a master's or bachelor's degree. For supervisor doesn't hold your hand and teach you how to do things. Most of it, you have to explore on your own".

4.2. Psychological Interaction

Situation recognition leads to psychological interaction between doctoral students and their environment. This interaction includes perceiving, evaluating, and feeling their academic selves in different situations, through which doctoral students enhance their understanding of academic identity.

Doctoral students perceive their academic selves in the context of their interaction with the environment. Their self-perception varies at different stages of their program, depending on their actual work content. For example, doctoral students at the initial research stage perceive themselves as "learners of research", with "immature" or "inexperienced" academic abilities (EN-21, Environmental Engineering, female). Doctoral student EN-20 (Computer Science, male), who is deeply engaged in knowledge production, views himself as an explorer of the unknown, and collaborates with his supervisor as a competent research partner.

In several instances, some doctoral students in the STEM field perceive themselves as academic employees and inheritors of knowledge. The former perspective is evident as these students interpret the material incentives provided by their supervisors as "compensation" for their labor (EN-7, Computer Science, male). On the other hand, the latter perspective is revealed in the transfer of tacit knowledge from doctoral students at advanced stages to those at earlier stages (NS-6, Biology, female). For example, EN-7 perceives himself as operating in the capacity of an employee while working on research projects for his supervisor, "I call my supervisor 'boss', and he pays me". NS-6 views it as her responsibility to guide the juniors, "my supervisor assigned a junior student to me, and I had to impart the basic skills and knowledge to him".

Through their interaction with the environment, doctoral students evaluate the value of their academic selves. There are two perspectives for evaluating academics: instrumental evaluation and intrinsic evaluation. Instrumental evaluation refers to students' assessment of academia based on its utility and interests, while intrinsic evaluation prioritizes the inherent value of academia and disregards other external value and purposes. The evaluation of academic selves by doctoral students encompasses both instrumental and intrinsic evaluation. On the one hand, they appreciate the role of academic research in generating practical benefits and enhancing their job prospects. On the other hand, they believe that academic research promotes knowledge accumulation and the satisfaction of curiosity. For example, EN-7 (Computer Science, male), embraces an instrumental evaluation perspective, believing that his doctoral academic training could position him to contribute to

cutting-edge projects in corporations, consequently earning considerably more than those with a master's degree. Conversely, HU-11 (Philosophy, male), from an intrinsic evaluation perspective, believes that his engagement in research within his discipline is driven by his interest and ambition in academia.

Doctoral students undergo a range of emotional experiences through their interactions with the environment. The sense of academic meaning refers to the feeling of meaning and satisfaction that doctoral students experience when engaging in academic activities. This sense is typically bolstered by positive feedback from the external environment as well as the student's internal motivation. These feedback experiences often occur when doctoral students recognize the substantive impact of academic research, receive validation from important others, achieve academic accomplishments, and strive toward self-actualization. For example, SS-3 (Education, male) experiences a strong sense of academic meaning when he realizes the impact his research has on others. The sense of academic efficacy refers to the student's belief in their capacity to accomplish specific academic tasks. Positive evaluations of one's capabilities, both from external environment and through personal self-assessment, can lead to an enhanced sense of academic efficacy. These experiences potentially extend from assessments of academic talents based on past experiences, self-evaluations of one's academic capability when engaging in scholastic activities, feedback from important others in their academic life, and increases in academic engagement. For instance, SS-14 (International Relations, female) expresses confidence in her research skills, stating, "Doing research is not particularly challenging; I seem to have a bit more talent in this area than most people".

4.3. Reflective Positioning

After situation recognition and psychological interaction with their environment, doctoral students reflect on whether they are researchers and whether they belong to the academic community. This study reveals that not all doctoral students at Chinese research universities manage to establish a strong academic identity, as the students approach self-reflection differently. Those students who view themselves as researchers have effectively incorporated the concept of academic identity into their self-image, suggesting that academic identity has been successfully transformed from an institutional identity authorized by higher education institutions [42] into a part of their self-identity. For example, EN-7 (Computer Science, male) identifies himself as a researcher following the production of original research outcomes. Similarly, SS-13 (Management, male) feels that he is embodying the role of a researcher due to his developed inquisitiveness.

The development of academic identity is notably influenced by a doctoral student's progression within their program. Doctoral students in the academic training stage recognize themselves as participating in research but do not yet see themselves as independent or mature researchers. SS-3 (Education, male) points out that "when it comes to writing papers, I view myself as a researcher, but not as an independent, mature researcher, instead, I'm more of a 'novice researcher'". These still-developing researchers are in a transitional phase, shifting from being students to becoming researchers. Doctoral students with such self-position often believe that they will eventually mature into full-fledged researchers.

There are some participants in this study who do not possess a defined academic identity. Instead, they identify themselves as students or exist in a state of uncertainty about pursuing a career as researchers. Doubts also arise regarding their ability to independently complete academic tasks. For example, NS-6 (Biology, female) feels that she still lacks the ability to conduct independent scientific research and requires further experience and assistance. Therefore, she identifies herself as "still a student". Some doctoral students exhibit a negative attitude toward engaging in academic activities and display a weak inclination toward choosing academia as a career, given their hesitation about becoming researchers. For instance, HU-16 (Archaeology, female) considers herself a non-researcher due to her perception that academic research lacks meaningful essence.

5. Different Patterns of Understanding Academic Identity

Due to the differences in the acquisition of academic meaning and academic efficacy during the process of doctoral programs, as shown in Table 3 and Figure 1, different doctoral students exhibit different characteristics in the patterns of understanding the academic identity, including Adeptness, Academic Pursuit, Alienation and Powerlessness, and Struggling for Meaning.
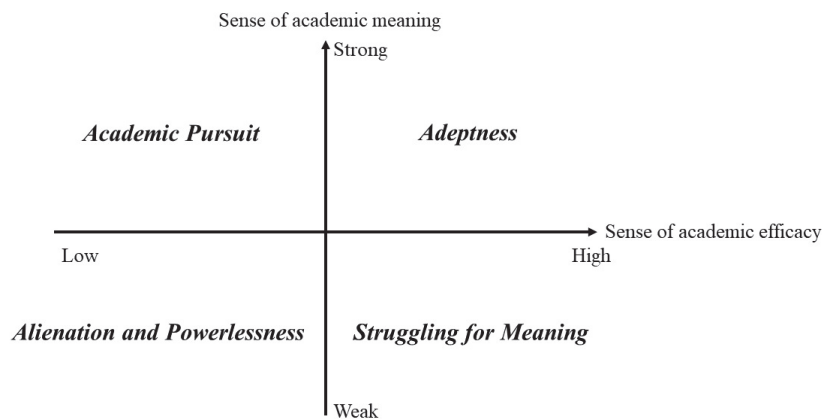
Figure 1. The patterns of understanding the academic identity.

5.1. Adeptness

Doctoral students in the "Adeptness" category can obtain a strong sense of academic meaning and efficacy from their academic experiences. These students hold a strong conviction that pursuing an academic career is a worthwhile endeavor, and they have confidence in their ability to conduct and complete scholarly research. Generally, they tend to position themselves within or in close proximity to the academic community. They also perceive their academic self to be well-placed within this sphere, and they express competence when navigating the relationship between academia and their personal selves.

> "I have a passion for philosophy because I find it is interesting. Making breakthroughs in research means a great personal achievement for me. Moreover, I see myself as a worker in this era, comparable to my peers. I feel proud to be an outstanding contributor. Personally, I prefer to call myself a researcher". (HU-11, Philosophy, male)

> "I have always been particularly interested in computers, and pursued my PhD to be able to do creative work in the future. Though it requires a lot of effort to do the researches, in the end, I manage to solve important issues. I believe that the research issues must be significant; otherwise, they are meaningless. Moreover, not only academia, but also the companies can utilize my research findings. I also have confidence in my abilities and have good publications. I have considered myself as a researcher from a very early stage". (EN-20, Computer Science, male)

5.2. Academic Pursuit

Doctoral students in the "Academic Pursuit" category obtain a relatively strong sense of meaning from their academic work, but their sense of efficacy is low. They believe that academic research is valuable and meaningful, but they lack confidence in their own ability to successfully achieve research results. These students position themselves on the periphery of the academic community and view the completion of academic tasks as a distant goal.

> "Even if the research project is obscure or very fundamental, and it may not have direct or immediate practical applications. I still firmly believe it provides answers to the unknown. However, I feel that my research abilities are still

insufficient, and I may need to read more articles published by others and conduct more experiments by myself. In my opinion, I am still a student". (NS-6, Biology, female)

"I believe that academia is very meaningful, and the research in our field is extremely significant to both the nation and society. It can directly benefit mankind. However, I feel that I'm not particularly suited for academia. Scientific research requires a huge amount of physical and mental effort, which I find exhausting. Experiments can't be interrupted, lasting at least 14 hours each time, and I am really worn out. Furthermore, I have bad luck. My hard-won paper was scooped by others, and I feel that I am still far from being a researcher". (EN-9, Engineering, female)

5.3. Alienation and Powerlessness

Doctoral students in the "Alienation and Powerlessness" category often have low levels of both sense of meaning and efficacy in academia. They struggle to recognize the value of academic research and suffer from a lack of confidence in their own academic abilities. They position themselves on the fringes of the academic community, lacking a sense of control over their academic work. This contributes to a sense of alienation and incompetence in regard to understanding their academic identity.

"There are too many ineffective, useless, and tedious affairs in our current scientific research. I used to think that engaging in academia was a very pure and sacred experience, where one could express his or her true ideas. Reality, however, has proven otherwise. In my long doctoral journey, I have realized that my mastery of knowledge may be inferior to my classmates and peers. You can work hard, spare no efforts to write articles every day, but can you produce good results? Maybe you can't. I have always considered myself as a student, still learning how to be a researcher". (SS-19, Politics, male)

"The reason I am pursuing a doctorate is simply to earn a higher salary after graduation. The value of research hardly matters to me, and I seldom appreciate the sense of meaning it brings. Therefore, I don't feel I need to become one of the members of the academic community. However, in order to graduate, I need to have publications. My supervisor seldom guides me and my ability of innovation is limited, which makes doing research extremely difficult for me. It is very likely that I will postpone my doctorate. I feel like I can't control the future, let alone be a researcher". (EN-12, Computer Science, Male)

5.4. Struggling for Meaning

Doctoral students in the "Struggling for Meaning" category have a weak sense of meaning obtained from academia but a high sense of efficacy. Despite their firm belief in their competence, they harbor doubts about whether academic research provides sufficient spiritual value. As a result, they experience conflicts and internal struggles when participating in academic activities. These doctoral students typically identify themselves as "non-researchers" or "researchers questioning the meaning of academia". They believe in their competent academic abilities and academic publications, while they derive less satisfaction from their research, leading to conflicts stemming from this perceived lack of meaning and value.

The participants' questioning of academic meaning is manifested through their doubts about the practical impact of research and the fairness of academic rules. When they cannot reconcile their research with their personal standard of meaningful work, they experience cognitive and behavioral dissonance, resulting in a struggle for meaning.

"About one-third of my work is just for publication, just to find a good position in academia. Much of this work is merely repetitive labor. I know that a part of my work is useless. We make attempts to solve very practical problems, yet its impact

on reality seems negligible. I don't experience excessive pressure in scientific research due to my research capability. If I fully devote myself to my research, I can produce a high-quality article within a month. I view myself as a researcher, yet the feedback received from my research endeavors often leaves me unsatisfied. The articles I publish are mostly due to employment pressures, which tends to render the process somewhat meaningless to me". (EN-15, Engineering, male)

"I feel that I have mastered research skills and have published an amount of academic achievements during my doctoral studies. While I perceive myself as a researcher, I am suffering from doubts. Research in our field should serve to address real-world challenges in businesses, but the academic community seems unable to respond to these requirements and ignores the criticisms from the business sector. The current academic evaluation system has resulted in a frenzy of publication for publication's sake, creating a frivolous academic atmosphere that I find meaningless. Hence, I choose to resist the prevailing academic rules by temporarily withdrawing myself from academia". (SS-13, Management, male)

In conclusion, doctoral students in China display significant differences in their process of understanding academic identity. This is due to the varying degrees of perceived meaning and efficacy they derive from academic situations and interactions. Consequently, this variation leads to different ways in which students position themselves.

6. Discussion

6.1. Academic Meaning: Internal Driving Force to Develop Academic Identity

The sense of academic meaning is related to the spiritual satisfaction experienced by doctoral students in their academic activities. From a psychological perspective, individuals are motivated not only by material rewards but also by the pursuit of meaning and spiritual value from their career. They desire to be able to express their true and complete selves at work and connect work and life with spiritual experiences [43]. Zhao and Guo pointed out that many young people hold the belief of "being anything they want to be" and have strong expectations for the meaningfulness of their career development [44]. Wellman and Spreitzer suggested that many organizational scholars were interested in making their careers more personally meaningful, while in academic careers, doctoral students and junior scholars may feel less autonomy to job craft, thereby creating negative impacts on the increasing meaning of work [45]. For doctoral students, the obtainment of academic meaning implies difficulties and challenges. Socialization is the process through which the doctoral students acquire the knowledge and skills, the values and attitudes, and the habits and modes of thought of the society to which they belong [10]. Therefore, the meaning they pursue must be generated during socialization. The experiences of doctoral students interacting with the discipline and institution significantly influence their evaluation of academic value.

Constructing scientific knowledge and deriving meaning from the experience of attending a doctoral degree are fundamental aspects making doctoral education unique [46]. The discipline, centered within academia [47], serves as an important context for the construction of doctoral students' academic identity. Academia is the soul of the discipline, and the process of knowledge exploration can generate a sense of value and dignity. Just as Weber regarded "inward calling for science", "enter into the idea that the destiny of his soul depends on his being right about this particular conjectural emendation at this point in this manuscript", "Without this strange intoxication (which appears faintly ridiculous to outsiders), without this passion, and without this feeling that 'thousands of years had to elapse before you entered life, and more thousands of years are silently waiting' to see whether or not your conjecture will be confirmed, one has no vocation for science and should do something different" [48]. As a researcher in reality, doctoral students' perception of the "inward calling" in academic community allows them to gain a sense of meaning and promotes the formation of their academic identity. Higher education institutions also provide doctoral students with the drive to undertake knowledge production and

interact with supervisors, peers, and important others who motivate doctoral students to perceive meaning in academic research. In addition, financial support from institutions significantly contributes to the success of doctoral students [49]. In terms of doctoral student socialization, meaning making related to money, which shapes doctoral students' identities as students and future professionals, may play a significant role in shaping whether doctoral students adopt the financial and monetary values, norms, and behaviors of their fields of study, departments, advisors, peers, and research laboratories [50].

In summary, the sense of academic meaning serves as the driving force for doctoral students, enabling them to perceive the value within their academic environment and facilitating the integration of their academic identity into their self-image. Conversely, a lack of academic meaning can result in insufficient motivation for doctoral students to construct their academic identity and engage in professional socialization processes.

6.2. Academic Efficacy: Psychological Conditions for Maintaining Academic Identity

Academic efficacy is a crucial psychological condition for doctoral students in forming their academic identity. Representing the power of positive thinking, self-efficacy has been consistently shown to exert a profound influence on individuals' motivation, achievement, and self-regulation [51]. Perceived self-efficacy refers to individuals' beliefs regarding their capabilities to produce designated levels of performance that influence events affecting their lives [52]. Individuals with high self-efficacy perception demonstrate greater resilience in their behavior, experience less anxiety and depression, maintain mental well-being, and achieve higher academic performance [53] (pp. 44–45). When confronted with stress, individuals with low self-efficacy tend to feel powerless, whereas those with high self-efficacy believe they can effectively control and cope with stress, thus perceiving it as less threatening [54]. According to Bong and Skaalvik [55], self-efficacy acts as an active precursor of self-concept development. When doctoral students perceive themselves as capable of academic tasks, they are motivated to embrace the role of a researcher. Therefore, a sense of academic efficacy contributes to the construction and maintenance of doctoral students' academic identity.

The environment and situation can significantly influence the level of self-efficacy [56]. For doctoral students, the environment that affects their sense of academic efficacy includes the disciplinary environment and institutional environment. Research conditions, academic atmosphere, and support from supervisors all impact on doctoral students' cognition and confidence in research activities [57]. Through interacting with key figures in the academic and institutional communities, doctoral students develop self-efficacy through the cognitive integration of the following four information cues: enactive mastery, vicarious experience, verbal persuasion, and emotional arousal [58]. Performances interpreted by doctoral students as successful make them receive positive feedback from academic activities, thus contributing to the maintenance of high levels of academic self-efficacy. Conversely, academic self-efficacy can influence their behaviors in academic research, potentially enhancing their overall sense of academic efficacy. According to Pasupathy and Siwatu, research self-efficacy is a significant predictor of research productivity among graduate students, and it also influences their research outputs by affecting their interest in conducting research [59]. As doctoral students produce more research output, they receive more positive feedback, reinforcing the relationship between research activities and performance interpretations, thereby strengthening their academic self-efficacy. Furthermore, academic self-efficacy also supports them to cope with academic pressure and challenges, which they usually face in academic training and knowledge production.

Doctoral students with a strong sense of academic efficacy are more likely to recognize their academic competence, facilitating the integration of their academic identity into their self-image. Conversely, a lack of academic efficacy makes it difficult for students to identify themselves as members of the academic community. Therefore, the sense of academic efficacy serves as a crucial psychological condition for doctoral students to construct and maintain their academic identity.

7. Conclusions and Implications

Improving doctoral education requires facilitating the transformation of doctoral students into independent researchers. Constructing an academic identity is highly important for the personal growth and future academic development of doctoral students. This study discusses how doctoral students in Chinese research universities become researchers from a psychological perspective and explores the psychological process and different patterns of academic identity comprehension. Based on the grounded theory, this study reveals that the sense of academic meaning and academic efficacy profoundly impact doctoral students' understanding of their academic identity. Throughout the dynamic process of academic identity construction, the sense of academic meaning and efficacy acquired from the interaction with the environment determine whether doctoral students can establish themselves as researchers. This provides an analytical perspective and research framework for exploring the doctoral students' identity formation. As doctoral students transition from students to researchers, their self-identity exhibits considerable fluidity and variability. Analyzing their academic meaning and efficacy can elucidate the characteristics of doctoral students' identity development and help to reveal the mechanisms underlying academic identity construction. In an era characterized by diverse employment opportunities for doctoral graduates, although academic professions are no longer the sole destination for all doctoral students, high-quality doctoral education should enable students to recognize their identity as researchers to fulfill educational objectives effectively.

The sense of academic meaning and efficacy serves as a driving force and psychological conditions for doctoral students to enter academic careers. Disciplines and institutions provide fields and contexts for doctoral students to acquire academic meaning and efficacy. As a member of an academic community, an academic is an individual who integrates into this community and constructs their academic identity. For most scholars, the doctoral stage is a period in which they form their academic identity. By deepening the knowledge in their discipline and engaging in academic interactions, doctoral students can cultivate a sense of academic meaning and efficacy, strengthen their identification within their discipline and institution, and naturally establish their academic identity. Conversely, without acquiring a sense of academic meaning and efficacy from their environment, doctoral students may struggle to realize their academic identity. The findings of this study expand the socialization model, enrich the socialization process of postgraduates that used to be analyzed from an external perspective by using the intrinsic perspective of doctoral students, explore the self-transformation of doctoral students in the socialization process by using the concept of "identity", and establish the direct connection between knowledge acquisition, investment, involvement, and doctoral identity.

The conclusions of this study could provide some suggestions for the advancement of doctoral education. The psychological state of doctoral students warrants attention from both supervisors and administrators. In today's academic profession, where excessive workloads and stress are increasingly prevalent, it is essential to assist doctoral students in dealing with stress, adapting to their surroundings, and solving psychological problems to maintain their mental health and foster a positive approach to challenges. In doctoral education, particular emphasis should be placed on enhancing the sense of academic meaning and efficacy. Only when doctoral students perceive the value of the scientific research they undertake can they establish a psychological recognition of their academic identity and subsequently embrace the responsibilities and obligations of researchers. When doctoral students have a high sense of efficacy, they can actively confront setbacks and failures in their academic research endeavors, fostering a stronger commitment and sense of belonging to the academic community. Therefore, supervisors and administrators should guide doctoral students in actively pursuing the meaning of research activities and conducting meaningful research. Moreover, they should prioritize enhancing doctoral students' sense of academic efficacy, especially during the early stages of doctoral socialization. Supervisors should provide guidance and support to help doctoral students understand the norms of the academic community, master the knowledge and skills necessary for academic research,

and integrate them into professional life. Doctoral students should also prioritize their mental well-being, consciously maintain and pursue meaning from academic activities, and proactively enhance their academic self-efficacy. Since all the interviewees came from research universities, this study did not identify any significant institutional differences. Furthermore, while we acknowledged how doctoral students understood academic identity from a psychological perspective at Chinese research universities, our study did not explore the diverse career paths these students may follow. An increasing number of PhD graduates are opting to leave academia. Future research could examine the impact of academic identity on the career decisions of doctoral students, as well as the relationship between academic identity and the performance of these students.

Appendix A

Table A1. Brief information regarding the interviewees.

Interviewee	Discipline	Gender	Year of Doctoral Program
NS-1	Physics	Male	Fifth
NS-2	Physics	Male	Third
SS-3	Education	Male	Fourth
SS-4	Education	Female	Second
SS-5	Education	Female	Second
NS-6	Biology	Female	Fourth
EN-7	Computer Science	Male	Third
HU-8	History	Female	First
EN-9	Engineering	Female	Fourth
NS-10	Chemistry	Male	Third
HU-11	Philosophy	Male	Fourth
EN-12	Computer Science	Male	Fourth
SS-13	Management	Male	Fourth
SS-14	International Relations	Female	Second
EN-15	Engineering	Male	Fourth
HU-16	Archaeology	Female	Third
SS-17	Law	Female	Second
HU-18	Philosophy	Female	Fourth
SS-19	Politics	Male	Fourth
EN-20	Computer Science	Male	Fifth
EN-21	Environmental Engineering	Female	Third

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