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Special Issue Reprint

Is Online Technology the Hope in Uncertain Times for Higher Education?

Edited by
Anthony G. Picciano

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Cover image courtesy of Anthony G. Picciano

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About the Editor

Anthony G. Picciano

Anthony G. Picciano is a professor and writer who has made major contributions to the study of education leadership, policy, research, and technology. He has more than fifty years of experience in college administration, teaching, and education technology. He currently is a full professor at Hunter College, the Graduate Center, and the School of Professional Studies, all at the City University of New York, and is associated with PhD, EdD, and graduate programs in education leadership and quantitative methods. He received a PhD in education leadership from Fordham University in 1986. His dissertation examined computer-support systems for decision-making in higher education and was based on the work of Nobel Laureate Herbert Simon.

Dr. Picciano has written more than twenty books and over eighty articles, book chapters, and monographs. He has edited eleven special editions for several leading professional journals. His articles have been published in the *Journal of Asynchronous Learning Networks*, *Online Learning Journal*, *Teachers College Record*, *Education Sciences*, *The Internet and Higher Education*, and *The Journal of Educational Multimedia and Hypermedia*.

Dr. Picciano was one of the founders of the Sloan Consortium of Colleges and Universities (Sloan-C), which today is known as the Online Learning Consortium (OLC). He was voted a life member and continues to serve on its Board of Directors. He was elected to the Inaugural Class of the Sloan Consortium's Fellows in 2010 and was also awarded the 2010 Sloan Consortium's National Award for Outstanding Achievement in Online Education by an Individual.

Dr. Picciano has been invited to speak, present papers, and participate in panels throughout the world. He has given guest lectures and seminars in Austria, Germany, France, the People's Republic of China, Morocco, Hong Kong, and South Africa.

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Editorial

Is Online Technology the Hope in Uncertain Times for Higher Education?

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Significant technological challenges are affecting societies across the world and online technology continues to assume a pivotal place in all organizations: commercial and non-commercial, governmental and non-governmental, and all forms of education. The reasons for this are threefold. First, the normal evolution of digital technology is highly competitive. Well-resourced global corporations such as Google, Amazon, Microsoft, Facebook, Baidu, Alibaba, and Tencent are investing billions of dollars in advanced technology such as AI and are continually developing new hardware and software products and services. These corporations are fully aware of their commanding positions and are committed to expanding and enhancing the role of technology in people's lives. Second, the world is still feeling the impact of the COVID-19 pandemic, which pushed organizations toward greater reliance on online technology to keep their operations afloat. During the pandemic, higher education developed almost total dependency on online technology to safely deliver services to its students. Third, in 2022, the introduction of generative artificial intelligence (i.e., ChatGPT) forced society, including our education institutions, to determine how to integrate AI into its operations. All organizations are now dealing with AI-related critical issues, including rapidly changing job functions and employee displacement. The same is true in higher education, as colleges and universities continue to migrate to online technology to support instruction, academic services, and administrative efficiency.

Even before the onset of the pandemic in 2020 and the emergence of AI in 2023, higher education had already begun to shift to a more online environment, with some observers predicting significant upheaval. Joseph Aoun, President of Northeastern University and author of *Robot Proof*, *Higher Education in the Age of Artificial Intelligence*, acknowledged colleges and universities as among the fullest expressions of human culture ever evolved and perhaps the most effective institutions for intellectual advancement ever developed, but he went on to caution that if they fail to respond creatively and deliberately to the technological challenges that they face, "they will wither into irrelevance" [1].

Drew Faust, former President of Harvard University, in a message to the World Economic Forum, in 2015, described the following three major forces that will shape the future of higher education:

- The influence of technology;
- The changing shape of knowledge;
- The attempt to define the value of education.

She went on to extol the facilities that digital technology and communications will provide for teaching, learning, and research. She foresaw great benefits in technology's ability to reach masses of students around the globe and to easily utilize large databases for scaling up and assessment purposes. However, she also cautioned the following:

"So much of what humanity has achieved has been sparked and sustained by the research and teaching that take place every day at colleges and universities, sites of curiosity and creativity that nurture some of the finest aspirations of individuals and, in turn, improve their lives—and their livelihoods. As the landscape continues to change, we must be careful

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to protect the ideals at the heart of higher education, ideals that serve us all well as we work together to improve the world" [2].

In March 2024, I was on a panel entitled, "Navigating Generative AI in Higher Education: Implications for Pedagogy, Research, and Collective Bargaining", during which I presented my views on how AI has entered societies across the world and immediately forced higher education to consider a myriad of pedagogical, policy, and ethical issues. Building on a foundation of nanotechnology and quantum computing, AI was combining with massive cloud computing, robotics, and biosensing/synthetic biology to evolve into a general man–machine interface model (see Figure 1), in which technology is infused in everything mankind does. These technologies are already visible, but in another decade they will mature, integrate, and realize their greatest impact.

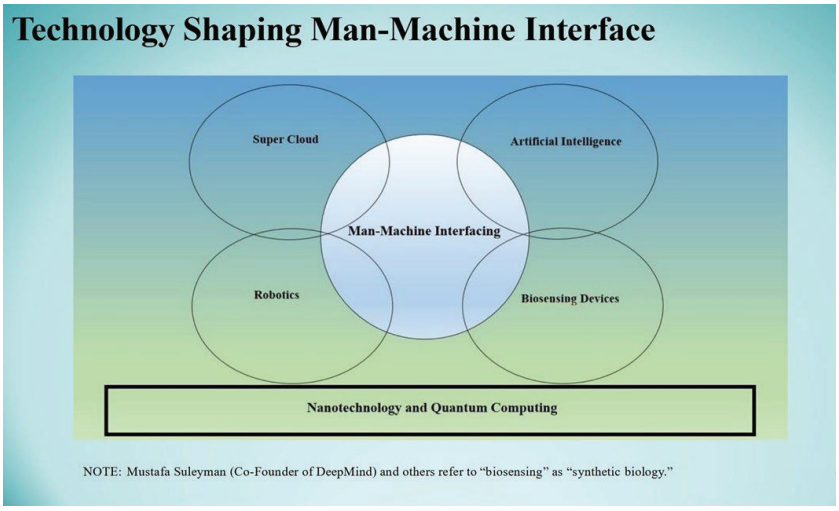

Figure 1. The evolving man–machine interface model [3].

The critical questions I raised in my discussion asked how educators will address and adapt to these new technologies.

In some cases, faculties may have to adjust to a tutor role, rather than develop their own content or pedagogical practices. There will be many more off-the-shelf courses developed at other colleges, universities, or commercial suppliers. While disruptive in some advanced societies, these practices could also lead to significant cost savings and expansion of higher-education opportunities in economically poorer countries. This will further accelerate a trend that commenced more than a decade ago.

Faculty researchers, especially those engaged in large-scale projects that involve multiple partners in the academy and in private industry, will work increasingly with AI algorithms. The lead researchers may not be people but the algorithms themselves.

Printed books and other library holdings have already moved rapidly to all-electronic access, with AI facilitating faster searches for materials and delivering them within seconds on mobile devices.

Teaching assistants, academic advisers, and counselors will see their roles simplified to offering assistance to students with personal needs and situations where the human side of advisement is most important. All advisement regarding course requirements, majors, and careers will be supplanted by AI applications.

Significant changes will occur in administrative and organization functions, where services will be consolidated, utilizing fully online cloud applications for admissions, registration, financial aid, bursaring, and purchasing. It is likely that large public university systems will be further centralized and merged, reducing the need for many administrative operations at the local campus level.

Many current educators may feel a loss of purpose as their expertise is overshadowed by AI software, while younger generations of educators will take their places, accept the new order, and work within it to make it successful. But the period of transition will be tense and perhaps difficult. Educators will be forced to accept technology as a primary partner in the education enterprise, as will their counterparts in the private industry [4]. The concept that technology changes, improves, and enhances is not the issue, but how people change in response to technology is. This will be education's challenge over the next decade and beyond. The timely and important questions raised and the issues explored in this volume can help us prepare for the uncertainty that rapidly advancing technology will bring to our world, specifically to our colleges and universities.

I thank *Education Sciences* for giving me the opportunity to edit a volume on such a critical topic. In particular, I thank the editorial staff, especially Sylvie Yang, who provided valuable and prompt assistance throughout the publication process. Most importantly, I thank the authors who contributed their research to this volume. Their work provides valuable insights for all interested in the future of higher education. Their perspectives are based on the study of issues across institutions in different parts of the world. They have examined a variety of topics, including data analytics, student evaluations, generative artificial intelligence, and MOOCs, to name a few, and employed a wide variety of research methods—both quantitative and qualitative. The sample sizes in these papers were varied, ranging from three case studies to a review of over two million responses collected on a student database. Detailed below are brief abstracts describing the ten submissions that were accepted for inclusion.

The Contributions

In "Developing a Next-Generation Model for Massive Digital Learning", Chris Dede and William Lidwell describe the development of massively open online courses (MOOCs) and their role, providing foundational models for remote learning during the COVID-19 pandemic and its aftermath. They concluded that insights from these models offer the opportunity for student engagement at scale, taking advantage of the strengths of online instruction, such as collapsing time, bridging space, personalizing via rich datastreams, using AI-based instructional assistants and learning partners, delivering content and experience across universities, and sustaining online learning communities after formal instruction ends. Furthermore, they posit that these advances can enable next-generation massive digital hybrid learning, a means to achieve the aspirational vision of universal global access to higher education.

Lucas Kohnke and Andrew Jarvis conducted a study of English-medium instruction (EMI) in Hong Kong when in-person classes were suspended due to COVID-19. The results showed that students faced particular challenges with reading and study skills (especially self-motivation), as well as vocabulary range, which affected more than one skill. Corroborating existing research, students with less secondary school EMI experience reported greater challenges. The authors' conclusion was that as online technology continues to deliver content in tertiary education, EAP courses must be closely aligned with the necessary language and study skills of students in these digital EMI environments.

Alyse C. Hachey, Claire Wladis, and Katherine M. Conway examined a sample of 780 students who dropped out of fully online and face-to-face courses in a large university system in the Northeast U.S. The results indicated that there were distinct differences in the patterns of reasons given by online and face-to-face students. Although the perceived quality of the instructor/instruction was deemed important to student persistence in both modalities, it seemed to be of greater importance when learning face-to-face. Furthermore, issues related to time were found to be more prominent reasons for the loss of online learners. The findings from this study shed new light on the reasons for online attrition, with implications for online policy and course design in a post-pandemic era.

Andrés F. Mena-Guacas, Jesús A. Meza-Morales, Esther Fernández, and Eloy López-Meneses studied the relationship between digital competencies and collaboration attitudes among 1316 higher education students in ten Spanish universities Their analysis indicated

that students who perceived themselves as more competent in using digital tools tended to have a slightly higher disposition to collaborate with their professors in virtual environments. Some competencies are more closely associated with collaboration than others. The results of this study underscore the importance of students acquiring strong digital skills to thrive in an increasingly digitized educational and work environment.

Charles Dziuban, Patsy Moskal, Annette Reiner, Adysen Cohen, and Christina Carassas examined student perceptions of instruction based on a total of 2,171,565 observations for all courses offered each semester from fall 2017 to fall 2022 at the University of Central Florida. The results indicated that 68% of students responded identically to each of the protocol's nine Likert scale items, essentially straight lining their rating of instruction and casting doubt on the validity of their engagement with the process. Student responses reflecting a variety of university demographics were also presented. The authors discuss the potential influences of students' reactions and present a possible model for effective teaching and evaluation. Their model provides a critical commentary on the evolving learning landscape. They conclude that by harnessing the power of data analytics, fostering open communication, and embracing ongoing assessment, instructors can create exemplary teaching experiences that empower students to reach their full potential.

Charles R. Graham, Ganbat Danaa, Tserenchimed Purevsuren, Adriana Martínez, Cinthia Bittencourt Spricigo, Barbara Maria Camilotti, and Tserenkhand Batsukh conducted international case studies examining universities in Colombia, Brazil, and Mongolia that were at different stages along the path of a digital pedagogical transformation. This article tells each story, including (1) what is driving the local need to engage in digital transformation, (2) what the major challenges and barriers are to achieving a transformation, and (3) what efforts are being made to help each university move along the path towards adoption and change. Three major themes emerged from the case studies: (1) the role of local policy in shaping digital transformation, (2) the importance of developing human capacity with technology, and (3) the potential for digital transformation to bring hope.

Julia Lynn Parra and Suparna Chatterjee examined critical issues related to social media and generative artificial intelligence. Using a combination of a current review of the literature and qualitative collaborative autoethnographic research, the authors took a step back and engaged in critical conversations about what we have learned from our uses of social media for learning in our online courses, with a focus on (1) the intentional uses of social media, (2) the challenges and concerning issues of social media tools, and (3) exploring the implications of artificial intelligence. Centering on the Special Issue's theme of "hope", the authors navigate these educational and technological landscapes and attempt to answer the question, "where do we go from here?"

Gregory C. Weaver, Paige L. McDonald, Gordon S. Louie, and Taylor C. Woodman examined the future for international virtual exchanges (IVEs) in higher education in the post-COVID-19 era. The authors systematically analyzed the literature published since the start of the COVID-19 pandemic, exploring methods, models, and the outcomes of IVE in higher education. This research was conducted according to the "Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews" (PRISMA-Scr) guidelines. Their findings demonstrate the potential for IVE to be scaled across higher education to promote the knowledge and skills required by a global ecology.

Catherine Manley conducted an action research study that focused on 37 institutional stakeholders who evaluated the potential of prescriptive analytics to project student outcomes in different simulated worlds. The goal of these prescriptions was to make recommendations to students about tutoring and to faculty about beneficial course redesign points. The study's analysis focused on the alignment of resources, processes, and values for feasible institutionalization of such analytics, highlighting institutional core values. She concluded that in the post-pandemic mix of online and on-campus learning under increasingly constrained resources, educational leaders should explore the potential competitive advantage of leveraging data from online technologies for greater student success.

In the concluding article, Alfred Essa examined a possible future for post-secondary education in the age of AI. The consensus view among economists is that AI is a general-purpose technology (GPT) similar to the steam engine, electricity, and the Internet. As GPT AI evolves, it holds the promise of fundamentally redefining the educational landscape, influencing not only current practices in institutional management and pedagogy but also shaping future trends in learning, evaluation, and accreditation. He also comments on possible cost–value equations that are evolving to support workforce development and lifelong learning.

I agree with Essa's assessment that advancing technology will not only be the hope for higher education but integral to its very essence.

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Article

Developing a Next-Generation Model for Massive Digital Learning

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Abstract: A decade ago, massively open online courses (MOOCs) were heralded as the solution to universal, global access to higher education. While they failed to reach this vision, primarily because of teaching-by-telling and learning-by-listening (a PDF of the residential classroom), MOOCs provided the foundational models and infrastructure for emergency remote learning in the pandemic. Reports of remote learning's death post-pandemic are greatly exaggerated, since the world is now irreversibly hybrid—and will stay that way because many people and organizations value the new opportunities this presents. From now on, when students leave the shelter of classrooms to interact with the world beyond schooling, they must have skills for adept performance both face-to-face and across distance. Colleges, universities, and regions that force all teaching and learning to be face-to-face are dooming their graduates to reduced agency in every other aspect of life. As discussed in recent reports from Harvard, MIT, and Stanford, innovative approaches to digital learning were developed during the pandemic that are now improving campus-based learning. Insights from these approaches offer the opportunity for student engagement at scale, taking advantage of strengths of online instruction such as collapsing time, bridging space, personalizing via rich datastreams, using AI-based instructional assistants and learning partners, delivering content and experience across universities, and sustaining online learning communities after formal instruction ends. Combined, these advances can enable next-generation massive digital hybrid learning, a means to achieve the aspirational vision of universal global access to higher education. A coalition of higher education institutions could begin to realize this vision, an essential step in enabling all learners to survive and thrive in our increasingly turbulent, disruptive global economy and civilization.

Keywords: hybrid; online; remote; MOOC; scale; massive; engagement; learning; instruction

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1. Introduction

In 2022, three leading universities (Harvard, MIT, and Stanford) each independently formed internal task forces to study innovative approaches to digital learning developed during the pandemic. These groups described lessons learned that could be applied to hybrid instruction now that campuses have reopened. The Harvard Future of Teaching and Learning Task Force report, *Reimagining the Classroom, Enriching Content, and Expanding the Harvard Community* [1], articulates the lessons the university learned from COVID-19-era remote teaching that might inform its future. The MIT Ad Hoc Committee report, *Leveraging Best Practices from Remote Teaching for On-Campus Education* [2], centers on the intense and broad emphasis in pedagogies for remote learning that the pandemic necessitated. The Stanford report, *Lessons from Teaching and Learning at Stanford during the COVID-19 Pandemic* [3], discusses five insights from mandatory remote learning that could be the foundation of a future institutional digital education strategy. Overall, the reports are similar in many of their conclusions but reflect the different missions and cultures of their institutions.

In 2023, the lead author of this article brought together the heads of the three teams that produced these reports in a special Silver Lining for Learning webinar to discuss cross-cutting themes and issues [4]. This article summarizes the reflections from that dialogue, which concluded that the world is now irreversibly hybrid—and will stay that way because many people and organizations value the new opportunities this presents. This means that higher education students must graduate with skills for adept hybrid performance both face-to-face and across distance. In its conclusion, this article discusses the possible emergence of a next-generation model for massive digital hybrid learning built on the insights from these three reports and other related resources.

2. Insights from the Three Reports Produced by Harvard, MIT, and Stanford

This section describes the major conclusions from each of the three reports as a foundation for synthesizing common themes and issues. The authors independently analyzed each report for key findings, then compared and synthesized their separate findings. The webinar described in Section 2.4 was used as an additional way to assess key findings by asking the report authors which insights they each considered most important.

2.1. Harvard University

The Harvard report, *Reimagining the Classroom, Enriching Content, and Expanding the Harvard Community* [1], posits that its residential community of students and researchers is precious and irreplaceable. The individual and collective innovations in remote teaching during the pandemic are seen as offering three opportunities to advance teaching and learning both on and off campus through new initiatives.

The first initiative is reimagining the classroom via blended teaching, infusing the best of online learning into residential settings and adding a residential component to online programs. Many faculty referenced strategies from remote teaching that could increase interactive learning in both face-to-face and online settings: chat rooms during discussions and lectures, breakout rooms and real-time collaborative workspaces for peer learning, and expanded expertise through involving professionals across distance. The objective of this initiative is to understand how online instructional insights can improve face-to-face teaching and vice versa.

The second initiative is enriching content via a campus-wide strategy for digital learning experiences that leverages accumulated faculty experience during the pandemic and enables connection with all types of learners everywhere. The default format of instruction changed from hour-long face-to-face courses to short-form digital content with flexible opportunities for interaction. Digital-first experiences move beyond transferring face-to-face instructional strategies to an online format (a PDF of the classroom) to instead building on the many short-form digital assets created by Harvard during the pandemic. Hybrid experiences can draw on multiple modalities to personalize learning to students' preferred approaches.

The third initiative is expanding the community by creating a virtual Harvard campus experience that remotely conveys the richness of residential resources. Blended experiences can make learning more active and collaborative; flexible experiences can make learning more inclusive and global. These innovations will require both varying policies to meet the circumstances of non-residential students and expanding campus-based services to provide multiple forms of access. Incentives will be needed to encourage faculty to engage in activities beyond typical residential teaching responsibilities.

Overall, Harvard's report advocates strategies to meet students where they are rather than limited by place or space, resulting in a more learner-centered, innovative, and equitable experience. Internal coordination and top-down support are necessary to enable innovation at the individual, program, school, and university-wide levels. External partnerships can complement internal initiatives in content creation, instruction, mentoring and advising, grading, and certification: coordination will be top-down, bottom-up, and middle-out. The report stresses that essential in all of these shifts is preserving and en-

hancing "the Harvard experience" while enabling delivery of "the brand" beyond full-time residential experiences in Cambridge, Massachusetts.

2.2. Massachusetts Institute of Technology (MIT)

The MIT report, *Leveraging Best Practices from Remote Teaching for On-Campus Education* [2], begins by noting that how one teaches at MIT varies enormously among departments and substantially even within departments. Given diverse instruction and bottom-up decision making, the pandemic-caused challenge was for each teacher at MIT to redesign instruction from first principles, to ask: What are our learning goals for students and how can we best help them to achieve these goals? To meet this challenge, MIT relied on extensive campus-wide sharing about how to teach; the report summarizes insights gained from these discussions.

Several common threads emerged from analyzing a 2022 survey of instructors. The first is that many faculty reported using varied strategies to deepen engagement among students and between students and instructors. These included extending traditional face-to-face office hours to take advantage of the convenience and less intimidating nature of Zoom interactions. Online office hours were also structured so that students could "stay after" and keep working together. "Problem set parties" provided an engaging way of reframing office hours. Adding undergraduate teaching assistants to complement traditional instructional supports increased opportunities for peer mentoring and counseling.

A second thread is shifting ways in which faculty innovate in instruction and grading. Across the campus, organizational changes were made to increase the efficiency and effectiveness of strategies for improving teaching. Video-based materials viewed prior to lab work helped in flipping the classroom and increasing the effectiveness of remote teaching. Take-home lab kits allowed active learning outside of campus facilities. Bringing in outside experts via Zoom increased the authenticity of learning experiences, enhancing their relevancy. The report recommends creating a standing Classroom Advisory Board with representation from faculty, staff, and students to foster and disseminate these and future instructional innovations.

A third thread is a strong emphasis on helping students to build community, maintain wellbeing, and develop a sense of belonging. The shutdown of the campus undercut standard pre-pandemic approaches to foster students' belonging, community, and mutual support. In response, classroom practices were highlighted that helped each student feel that their ideas mattered and their perspectives were welcomed. Structured active, interactive, and collaborative learning were adopted in many courses. For example, faculty in the history department created partnerships with other faculty teaching similar courses at universities around the world, enabling student interactions across contexts and cultures. Innovations included new flexibility with deadlines, alternative/flexible grading schemes, ways of beginning classes with wellbeing and community in mind, and mentoring programs.

Overall, MIT's report centers on compiling and sharing the many innovative practices that its instructors are using, in order to expand those isolated innovations to common usage across the campus. The proposed Classroom Advisory Board is recommended as a major mechanism for accomplishing this. This would complement and extend MIT's current instructional infrastructure of the Teaching + Learning Laboratory, the Digital Learning in Residential Education team within Open Learning, school-based Digital Learning Labs, and the Committee on Curricula.

2.3. Stanford University

The Stanford report, *Lessons from Teaching and Learning at Stanford during the COVID-19 Pandemic* [3], describes the impact of the pandemic on instruction and learning, including its effect on different types of students. The report highlights how the pandemic suddenly fractured the level playing-field provided for students by the campus: some students had no homes to return to outside of campus housing, loss of a campus job impacted some

families' financial situation, and other students returned to new caregiving responsibilities in a stay-at-home world. Further, in a survey during spring 2020, nearly 80% of student respondents indicated difficulties with the emergency remote teaching the university was providing. Beyond having a quiet place to work and study, as well as reliable internet access, students struggled with long lectures on computer screens. To aid with these challenges, the university provided additional resources, such as shipping laptops to students in need and selectively supplementing standard financial aid.

In addition, Stanford emphasized developing compassion and empathy in the virtual classroom. Instructors utilized various types of community-building tools. Many curricular practices were reshaped to promote active, interactive, and experiential education. Departments held more widespread and extensive discussions about teaching than had ever occurred. New academic and professional communities were formed, such as a "teaching commons" website and free online workshops to share ideas about remote instruction. Both new instructors and seasoned faculty had to rebuild their courses from the ground up to teach them remotely, facing comparable academic burdens. Faculty who modeled resilience and flexibility in their teaching were inspirations to students in terms of tenacity and innovation.

Students indicated greater engagement in courses with creative instructional designs. For example, back-channel conversations in Zoom encouraged participation from students reluctant to speak up in class, enabling them to find their voices in an online community of inquiry. The fluid creation and dissolution of breakout rooms in Zoom aided in using small group discussions to balance whole class dialogues. Flexible instructional practices included organizing class time into shorter segments with a wide range of instructional modalities and more interaction than a typical lecture-based class. "Flipped learning" (asynchronous delivery of instructional materials followed by collaborative projects or discussions during synchronous class time) was helpful in both engagement and learning. Repurposing previously recorded video enabled more time for interpretative discussion and for complementary dialogue with guest speakers. Learning kits shipped to homes created opportunities for lab experiences. Some departments experimented with hybrid-flexible (hyflex) course formats, in which students could participate in class synchronously online, synchronously in person, or asynchronously online.

Many faculty shifted from high-stakes summative tests to formative, scaffolded, and lower stakes assessments. This helped students diagnostically to understand weaknesses in their current knowledge and to use support materials to remediate these. Overall, assessments became more project-driven and frequently focused on essays. However, in large courses that retained traditional high-stakes exams, cases of student cheating increased substantially over pre-pandemic levels.

Innovative types of teaching support models emerged. Students took on new roles in classrooms: learning management system administrator, peer advisor, technology expert, academic thought partner. The university's educational technology support teams were expanded. Student access to mobile devices like laptops and iPads was improved. Teaching and learning resources were digitized for easy access.

A major emphasis in the Stanford report is on supporting the whole student, such as creating new programs to enhance wellbeing, fostering positive connections among students and faculty, and developing inclusive and collaborative instructional practices. Particular emphasis is placed on helping students severely affected by the pandemic, those with low socioeconomic status, who are first generation, or who face family/life challenges. Overall, the report concludes that emergency remote instruction led to a shift in Stanford's identity, particularly in how students engage with the university's cultural traditions and how faculty and staff can foster a community of empathy.

2.4. Cross-Cutting Themes and Issues

As mentioned above, in 2023 the lead author of this article moderated a special online event, a Silver Lining for Learning episode in which the heads of the three teams

that produced these reports discussed cross-cutting insights [4]. As with the reports, this webinar's dialogue was shaped by the different missions and cultures of the three institutions. Three cross-cutting themes emerged. The themes below confirm the validity of our analysis conducted on the reports individually, as discussed earlier.

First, at each university instructors were forced to rethink their teaching. The institutions created a climate of experimentation and prosocial innovation. Inclusive classroom spaces—both physical and digital—were promoted. Faculty and teaching staff were supported in learning management system (LMS) usage, in interactive andragogy, and in blending active learning into assimilative instruction. In contrast to making incremental adaptations, strategies that enabled the transformation of conventional course models were encouraged.

Second, all these universities prioritized student engagement, both with peers and with instructors. Across multiple dimensions, meeting learners where they are was emphasized. Strategies for digital engagement were developed, including ease and equity in access to virtual learning-spaces. Empathy was highlighted, as remote interaction creates challenges in life as well as in learning.

Third, all the institutions moved toward student-centered education, focusing on learning experiences both in and outside of physical and virtual classrooms. Synchronous, asynchronous, and blended options were offered; and enriched digital content was provided. Strategies were developed to enable ideas, values, and relationships to be enhanced in ways that do not require physical co-location; the goal was virtual communities of inquiry.

An overarching theme that emerged was achieving high levels of student engagement online, at scale. In 2012, massively open online courses (MOOCs) succeeded in delivering content at scale, but failed in their aspirational visions, in part because student engagement was low compared to face-to-face settings. The pandemic underscored that motivation is the handmaiden of learning and forced instructors and institutions to prioritize student engagement and wellbeing.

Two types of initiatives may aid in achieving this goal. First, advances in online learning, described throughout this analysis, are aiding with student motivation and support. Second, these innovations now can be complemented by recent gains in generative artificial intelligence (AI), such as the emergence of large language models like ChatGPT. Recent developments in both these areas are described in the next section.

3. The Goal of Engagement at Scale

This section discusses illustrative scholarly activities across the field of higher and adult education on the crucial issue of enhancing student engagement in large online learning experiences. These sources and insights are drawn from the lead author's analyses and student-centered instructional design in teaching an online graduate course on motivation and learning each academic year.

The Community of Inquiry framework is a widely used model for developing and evaluating online education [5]. The three dimensions in this framework are social presence (each learner can express their identity in community interactions), cognitive presence (participants in the community construct meaning through sustained communication), and teaching presence (the design, facilitation, and direction of cognitive and social processes to realize personally meaningful and educationally worthwhile learning outcomes) [6]. All three of these dimensions have affordances that can heighten student engagement [7–9].

The lead author is a Co-Principal Investigator and Associate Director for Research of the National Artificial Intelligence Institute for Adult Learning and Online Education (AI-ALOE), which is funded by the U.S. National Science Foundation [10]. Its mission is "to conduct responsible use-inspired fundamental research into AI that is grounded in theories of human cognition and learning, supported by evidence from large-scale data, evaluated on a large variety of testbeds, and derived from the scientific process of learning engineering." Its aspirational vision is to develop novel AI theories, techniques, and tools to enhance the proficiency of online adult learning at scale to make that modality comparable

to similar face-to-face offerings for occupation-related learning, particularly in science, technology, engineering, and mathematics (STEM) fields.

Some of AI-ALOE's work centers on enhancing social, cognitive, and teacher presence to increase student engagement. For example, Ashok Goel at Georgia Institute of Technology is leading the development and deployment of an AI tool called SAMI that takes learners' self-introductions in an online class as inputs and analyzes these to help build connections among the learners [11]. SAMI uses natural language processing for understanding learner's self-introductions and matches knowledge graphs to identify connections among the learners. More recently, SAMI has started making recommendations for team formation and is now utilizing ChatGPT for named entity recognition and other language tasks.

To enhance students' cognitive presence, among other apps AI-ALOE is developing an interactive inquiry-based learning environment called VERA for enabling a learner to interactively construct graphical models of an ecological phenomena, evaluate the model through agent-based simulation, analyze the results, and revise the graphical model [12]. VERA provides access to Smithsonian Institution's Encyclopedia of Life, a digital biodiversity library, to help learners construct conceptual models and set parameter values for the agent-based simulations. To enhance cognitive engagement, VERA incorporates learning by doing, learning by simulation, learning by reflection, and peer-to-peer learning.

As another example, AI-ALOE is evolving an AI tool called Jill Watson for enhancing teacher presence by automatically answering questions posed by learners in online discussion forums any time, any place [13]. Jill Watson combines digital libraries for storing answers to previously asked questions, natural language processing for classifying new questions, and machine learning techniques for retrieving answers and generating a novel answer for the new question.

Across the field of online learning, other research teams are developing and studying scalable innovations to enhance student engagement. As one illustration, Victoria University in Australia has developed an innovative public–private partnership that delivers a resources-sufficient model of fully online postgraduate education with high levels of academic student support [14]. Learning analytics that track student engagement trigger responsive support by trained staff available beyond standard business hours. To aid this type of strategy, other research teams are studying which types of online behavioral indicators provide good metrics for student engagement (such as detection of instances when learners feel isolated, bored, distracted, or prone to procrastination) [15].

Student engagement has also been increased by using AI to hone the pedagogical craft of teachers. For example, Stanford researchers have used an AI tool to analyze transcripts of classes and provide timely feedback to teachers, increasing the use of an engagement strategy called "student uptake"—i.e., incorporating and building upon student contributions in class discussions—by 13%, which improved student learning and satisfaction. [16]

A recent systematic review highlights multiple approaches to analyzing student engagement including automated analysis of log, text, image, interview, and survey data [17]. Another review assesses the impact of self-directed learning on student motivation and learning outcomes, finding a medium effect size across fourteen studies [18]. Overall, the prevalence of researchers developing interventions that increase student engagement in massive online learning is encouraging.

The characteristics and capabilities of instructors are also important in increasing student engagement. A study of teacher educators as gatekeepers highlights the information and communication technology skills and attitudes needed by professors to effectively implement learning technologies for student motivation and learning [19]. The design of instructional infrastructure, such as using online simulations in teaching, can also aid student engagement [20].

Beyond incremental gains, when combined, all these enhancements could lead to transformative models for next-generation hybrid massive learning.

4. A Grand Challenge

The field of learning technologies has evolved in cycles of incremental improvements in teaching, learning, and assessment leading to occasional transformational change [21]. Infusing situated learning through immersive games and simulations is one example of this; incorporating social media to enhance collaborative learning is another. Doing things better can provide a foundation for doing better things.

A decade ago, MOOCs were heralded as the solution to universal, global access to higher education. While they failed to reach this vision, primarily because of an exclusive focus on teaching-by-telling and learning-by-listening, MOOCs provided the foundational models and infrastructure for emergency remote learning in the pandemic. This article discusses how far the field has come in providing both engagement and learning at a massive scale. Advances in engineering learning are enabling the types of infrastructure needed to achieve global delivery [22].

Today, we sit at an inflection point that represents the most rapid and significant revolution in the history of education: augmentation of human intelligence with artificial intelligence. When describing the potential synergy of human–computer interaction, the late Steve Jobs likened the computer to a "bicycle for the mind" [23]. By amplifying human ability to spectacular magnitudes, intelligence augmentation using AI can work to increase students' cognitive flexibility, creativity, and critical thinking, unlocking wholly new ways of learning and thinking. If a computer is a bicycle for the mind, a computer running AI is something an order of magnitude beyond—a human–computer synergy potential for which there is no apt efficiency metaphor.

While many forecasts chart an evolution of AI towards taking human jobs, more likely is a future where AI changes the division of labor in most jobs, driving a need for workforce development to shift towards uniquely human skills [24]. Specifically, AI is becoming increasingly proficient at calculation, computation, and prediction ("reckoning") skills. As a result, we will see increased demand for human judgment skills such as decision making under conditions of uncertainty, deliberation, ethics, and practical knowing. For example, in the Star Trek series, Captain Picard's judgment, decision making, and deliberation skills are enhanced by the reckoning, computation, and calculation skills of Data, an android lacking human abilities.

In light of this, the grand challenge for higher education is not merely to understand how remote learning and AI can scale present capabilities, but to also use this moment to reflect and reimagine the learning experiences of students. With the advent of the Internet and search engines, content knowledge has already largely become an on-demand commodity. With ever-improving telecommunication technologies, meetings with instructors and classmates can happen anytime from anywhere for little to no cost. Online collaboration tools like Google Workspace and Microsoft 365 enable remote groups to co-create and share feedback synchronously and asynchronously. And with the increasing availability and sophistication of AI-driven tools, the capacity to automate the mechanics and minutiae of typical knowledge- and skill-based tasks is growing at an exponential rate. The college experience of tomorrow need not—and, indeed, should not—look and feel like the college experience of yesterday. These technologies have untethered both the minds and bodies of students, freeing them and their institutions to focus on higher-order thinking skills while better leveraging the world around them, but their collective potential is far from fully realized.

Such a shift will require not only institutional learning, but also "unlearning" [25]. Faculty and leadership in higher/continuing education will have to let go of deeply held, emotionally valued identities in service of transformational change to a different, more effective set of behaviors. This is both individual (an instructor transforming instructional practices from presentation and assimilation to active, collaborative learning by students) and institutional (a higher education institution transforming from degrees certified by seat time and standardized tests to credentials certified by proficiency on competency-based measures). Unlearning requires not only novel intellectual approaches, but also individual

and collective emotional and social support for shifting our identities—not in terms of fundamental character and capabilities, but in terms of how those are expressed as our context shifts over time.

The earlier discussion of what leading universities learned from pandemic-era remote teaching highlights the barriers and challenges involved in making a shift to new models of instruction, assessment, and student support. In each setting, major shifts in institutional policies, practices, and investments were recommended to mitigate these hurdles. Time and further research will tell which of these improvement strategies provide the most leverage and which are generalizable beyond the specific institution at which they were implemented.

Despite numerous barriers to change, reports of remote learning's death post-pandemic are greatly exaggerated, since the world is now irreversibly hybrid—and will stay that way because many people and organizations value the new opportunities this presents. From now on, when students leave the shelter of classrooms to interact with the world beyond schooling, they must have skills for adept performance both face-to-face and across distance. Colleges, universities, and regions that force all teaching and learning to be face-to-face are dooming their graduates to reduced agency in every other aspect of life. Transformative models for next-generation hybrid learning are an important next step for higher and continuing education. Students must be prepared both with specific knowledge and skills for their first job and with cross-cutting capabilities for the multiple careers they will experience in a half century of work [26]. A coalition of higher education institutions could begin to realize this vision, an essential step in enabling all learners to survive and thrive in our increasingly turbulent, disruptive global economy and civilization.

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Article

Addressing Language and Study Skills Challenges in Online Undergraduate EMI Courses

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Abstract: English-medium instruction (EMI) is taking hold within higher education in non-Anglophone settings, but there is insufficient research into the challenges students encounter when taking EMI courses online. This exploratory quantitative study conducted in Hong Kong examines the language and studying challenges faced by undergraduate students when in-person classes were suspended due to COVID-19. One hundred thirteen first- and second-year students completed a questionnaire, rating their perceived challenges in the areas of writing, speaking, reading, listening, and study skills. The results showed that they faced particular challenges with reading and study skills (especially self-motivation), as well as vocabulary range, which affected more than one skill. Corroborating existing research, students with less secondary school EMI experience reported greater challenges. As providing English for Academic Purposes (EAP) courses is a primary way to support the language skills of students in EMI settings, we offer guidance to EAP practitioners who seek to help their students overcome the challenges identified in this article. As online technology continues to deliver content in tertiary education, EAP courses must be closely aligned with the language and study skills needs of students in digital EMI environments.

Keywords: English for Academic Purposes; English-medium instruction; language; study skills; online learning; EAP; EMI

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1. Introduction

Over the past two decades, higher education has witnessed a surge in English-medium instruction (EMI) programmes in settings where English is not the first language of most students and teachers [1,2]. EMI refers to teaching academic subjects in English without an explicit focus on developing students' language skills [3]. However, such programmes can be demanding for students who are not accustomed to taking courses and dealing with content in English. Accordingly, English for Academic Purposes (EAP) courses are sometimes offered to facilitate language development and provide targeted support that will help students succeed in the EMI environment [4]. These EAP courses target students' proficiency with academic language and genres [5–7] and are often designed based on a needs analysis [8]. Previous studies (e.g., [9–11]) investigating the needs of EAP students have identified insufficient writing skills as their primary difficulty. Conversely, they have found that listening skills pose a minimal challenge [12].

In spring 2020, the COVID-19 pandemic forced higher education institutions worldwide to suspend in-person teaching and adopt emergency remote teaching (ERT) [13] using online learning environments (e.g., Blackboard, Moodle, Zoom, Microsoft Teams) [14]. Though EMI courses in Hong Kong and other locations had previously utilised both synchronous and asynchronous technologies (e.g., learning management software, blogs, wikis, mobile apps, student response systems), the necessity of transferring entire courses online presented many challenges and constraints [15]. Studying in a fully online environment

was difficult for EMI students. As language and study skills are paramount to their success, this article seeks to explicate the specific subskills EMI learners found challenging during ERT. Moreover, few studies have focused on such challenges in online EMI courses. By identifying these specific needs, this article can guide future EAP curriculum design and pedagogy to facilitate academic success in digital EMI higher education settings.

2. Literature Review

2.1. Emergency Remote Teaching

At the beginning of the COVID-19 pandemic, the daily lives of teachers and students changed abruptly and ERT became necessary [16]. ERT provides higher education institutions with a way to deliver synchronous instruction remotely when in-person classes are suspended [13]. Before the pandemic, the integration of technology had become a cornerstone of successful EAP practice [17]. However, the materials, activities, and assessments that teachers used had been purposefully designed for either asynchronous or synchronous delivery, in contrast to ERT, where content needed to be assembled rapidly [18]. This new and unique environment significantly altered the ways in which EAP students learned. Traditionally, incorporating technology in the EAP classroom can take various forms, including drills to practise skills, reading or writing, and sharing images or artefacts that facilitate language acquisition while students work on authentic tasks. EAP teachers also incorporate student response systems (e.g., GoSoapBox, Mentimeter, Kahoot!) to encourage interaction, satisfaction, and a sense of community [14,19]. Despite this, the transition to ERT revealed a lack of digital competence and readiness to create fully online engaging and interactive EAP lessons among instructors [14]. Students faced many obstacles during ERT, including technical issues, low computer literacy, difficulty understanding the material, poor concentration, and low motivation [20]. Furthermore, many students accessed ERT classes via their smartphones [21] or had limited communication with their peers and instructors, making them feel isolated during the learning process [22]. These students had to conform to the institutional and disciplinary conventions of a new learning environment, a challenge that was exacerbated for students whose first language was not English.

In addition, EAP students are expected to comprehend and produce texts written in academic English, which can be difficult even in traditional classroom settings. In the online environment, this task is significantly more challenging. The replacement of face-to-face communication with written communication heightened existing language difficulties: text-based communication requires a higher level of language proficiency and can lead to misunderstandings and miscommunications due to the lack of non-verbal cues [22].

Furthermore, online learning requires a high degree of self-regulation and time management, which can pose additional challenges for EAP students [20]. They may struggle with procrastination or find it difficult to stay on top of their coursework because of the additional time they need to process and understand materials in English [20,22]. Another challenge EAP students struggle with in an online academic environment is navigating different cultural norms and expectations. For example, students from cultures where it is considered inappropriate to question or contradict their instructors and/or classmates may find it challenging to engage in critical debate and discussion online, which is often encouraged in Western academic contexts [11]. Therefore, it is crucial for educational institutions and instructors to provide the support and resources necessary to help these students succeed in an online learning environment.

2.2. Language Challenges

In language teaching and learning (especially EAP), an analysis of learners' needs can guide curriculum development [8] and help administrators, course developers, material writers, and instructors teach students the language skills they need for academic success [23].

The foremost challenge faced by EAP learners in Hong Kong is academic writing [9]. In particular, students lack adequate discipline-specific vocabulary [4,9] and find the way

general academic terms are used in the disciplines to be challenging [24]. First-year students, fresh from their secondary school studies, are accustomed to different writing standards than those that dominate in higher education [25]. One study found that EAP learners struggled with morphology and grammar [26]. In addition, they have difficulty employing academic citations [27]. They may need to learn more sophisticated sentence patterns and engage more deeply with the content than they did in secondary school.

Moreover, EAP learners also find it difficult to discuss academic content and speak in fluent, grammatically correct, and intelligible sentences [4]. The development of speaking skills requires instructor input, followed by learner output, and subsequent instructor feedback. However, EAP courses tend to focus on presentations [28] and neglect pronunciation [29,30]. Furthermore, EAP learners often struggle to critically select, paraphrase, and summarise information from academic journals and texts [26]. As scholars have highlighted [31–33], readings in secondary schools are generally provided by the teacher, whereas in higher education students are expected to locate and read a wide range of academic texts [9]. However, they may struggle to use library search tools to find relevant materials. Additionally, they may have difficulty guessing the meaning of unknown words [34] and understanding background information [35], preventing them from comprehending academic texts.

Listening is often reported to be the least challenging skill for EAP learners [12]. Nevertheless, weak comprehension of spoken English still impedes academic success. One study documented that many learners struggle to comprehend informal expressions and take effective notes [30]. Some students find it challenging to understand lectures [36] because they lack discipline-specific academic vocabulary knowledge [37]. This issue can be exacerbated because instructors speak English with various accents and deliver lectures in a style that students perceive as quick and unfocused [38].

2.3. Challenges with Study Skills

The challenges that students face with writing, reading, speaking, and listening are also linked to their study skills. Scholars [38,39] have pointed out that incorporating lessons on preparation strategies, such as developing background knowledge of the content that will be covered in a lecture, can facilitate listening comprehension [40]. This implies that improving these skills should be a compulsory component of EAP courses. It has been observed that learners are unable to plan and revise their writing and have difficulty managing their time, which hampers their productivity [41]. Though studies are scarce, there is some evidence suggesting that EAP students would welcome instruction on study skills. One study reported that students responded positively to the critical thinking of an EAP course [42]. Similarly, another study [43] found that embedding a study skills module in an EAP course enhanced students' coping skills, time management, and reflection.

To inform decisions regarding which (sub-)skills should be emphasized in EAP courses during ERT, this study employed a questionnaire that asked learners to rank the difficulty of each major skill and subskill. It was guided by the following research questions:

RQ1: Which language skills and subskills did EAP learners perceive to be the most challenging during ERT?

RQ2: Which study skills did EAP learners perceive to be the most challenging during ERT?

3. Methods

3.1. Participants and Context

The participants in this study were 113 first- and second-year students at a large English-medium institution in Hong Kong taking a compulsory EAP course entitled 'English for University Studies'. This is a 'bridging course. . . that brings students up to speed with general academic English' [43] (p. 2). It aims to facilitate academic success by focusing on four learning outcomes: the ability to (i) refer to sources in written texts and oral presentations; (ii) paraphrase and summarise materials from written and spoken sources; (iii) plan, write, and revise expository essays with reference to sources; (iv) deliver effective

oral presentations. It is a three-credit course delivered over 13 weeks, with three hours of instruction each week. At the time of the study, most students at the focal university were taught online due to the COVID-19 pandemic, though departments were permitted to deliver some smaller classes face-to-face. This EAP course was taught fully online.

The survey was sent out to 150 students enrolled in the EAP course. A total of 113 completed responses were received from 86 first-year students and 27 second-year students (60% of whom were female). They were invited to participate in the study. All spoke Chinese as their first language and English as their second language. The sample included students from a broad range of disciplines, including health, social sciences, design, construction, environmental science, engineering, and the humanities. Most participants had attended secondary schools where most subjects were taught in English, but 17 participants had attended schools where instruction in Chinese was dominant. Before being asked to sign a consent form, each participant was informed about the scope of the research, the proposed use of the collected data, and their right to withdraw at any time. The study received ethical approval from the university.

3.2. Instruments

The data collection instrument was a self-administered online questionnaire (in English) (see Appendix A) that explored students' challenges with language and study skills. To inform our decisions (as part of the overarching aim), we perceive knowledge on challenges in language skills and subskills to be a relatively objective trend. Therefore we adopt a positivist approach and use only the questionnaire to answer our research questions.

The participants completed the questionnaire between weeks 7 and 10 of the first semester. The questionnaire employed a 5-point Likert scale (ranging from 1 = *very challenging* to 5 = *not challenging*) to measure the level of difficulty the participants experienced related to each skill. Likert scales are advantageous when exploring complex issues, such as challenges with language and study skills, which cannot be adequately captured by simple 'yes' or 'no' responses [44]. The questionnaire items were adapted from a previous study [4,45] and the researchers' observations as EAP practitioners. The questionnaire was expert-piloted by three students (who did not participate in the study) and three teachers. They provided feedback on individual items, instructions, visual layout, and potential ambiguities related to problematic wording and complexity. We analysed and deleted or rephrased questions to eliminate these ambiguities before finalising the survey [46].

3.3. Data Analysis

Data from the study were analysed using SPSS 24.0. In the reliability analysis, the mean Cronbach's alpha for all subskills was 0.973, demonstrating that the questionnaire had high internal consistency. To rank-order the difficulty level of the subskills under each major skill, we calculated their means. The difficulty levels of the major skills were rank-ordered in the same way. A series of independent samples *t*-tests were performed to identify differences in the perceived difficulty of each major skill and subskill between students who were taught mostly in English in secondary school and those who were not. Cohen's *d* for each independent samples *t*-test was manually calculated to report the effect size.

4. Results

4.1. Skill Difficulty

In this section, we identify the main challenges students experienced with the five major skills and the corresponding subskills.

4.1.1. General Results

Table 1 presents the descriptive statistics related to the major skills. The participants perceived reading as the most challenging skill required in their university studies, followed by study skills, speaking, writing, and listening. Interestingly, these findings diverge from

the results of previous research conducted in face-to-face settings, which identified writing as the most difficult skill.

Table 1. Descriptive statistics—five major skills.

Skill	*N*	Minimum	Maximum	Mean	Std. Deviation
Writing	113	1.25	5.00	3.0631	0.76585
Speaking	113	1.00	5.00	3.0274	0.90062
Reading	113	1.17	5.00	2.9263	0.86830
Listening	113	1.83	5.00	3.6224	0.94544
Study skills	113	1.00	5.00	2.9967	0.89587

4.1.2. Specific Results

Table 2 ranks the writing subskills based on their perceived difficulty, as reported by the EAP students. The participants found that using academic or technical vocabulary was the most challenging subskill, which is consistent with the findings of previous studies [4,9,10,24]. Other notable challenges include critically evaluating ideas from sources, employing a diverse set of vocabulary words or synonyms, and expressing ideas clearly and concisely.

Table 2. Descriptive statistics—writing subskills.

Difficulty	*N*	Minimum	Maximum	Mean	Std. Deviation
Using academic/technical vocabulary	113	1	5	2.86	0.999
Critically evaluating ideas from sources	113	1	5	2.91	1.005
Using synonyms/a range of vocabulary	113	1	5	2.92	0.992
Expressing ideas clearly and concisely	113	1	5	2.95	0.971
Producing grammatically correct sentences	113	1	5	3.11	1.055
Using an appropriate tone/formality	113	1	5	3.12	0.992
Citing sources correctly	113	1	5	3.20	0.918
Using an appropriate essay structure	113	1	5	3.43	0.981

In contrast, the students considered that producing grammatically correct sentences, adopting an appropriate tone or level of formality, and accurately citing sources were less challenging. They found that using an appropriate essay structure was the least difficult writing subskill. Using online grammar tools may have contributed to the accuracy of the students' writing, and the clear guidelines on referencing and structure provided in the EAP subject materials might have made these aspects easier for students to implement than other aspects.

In terms of speaking subskills, the students reported experiencing significant difficulties with varying their language, engaging their audience, and speaking persuasively (see Table 3). In contrast, less challenging speaking subskills included referencing sources in presentations, employing stress and intonation, exuding confidence, and adopting a suitable speaking tone. The least difficult skills were speaking fluently, explaining themselves clearly, and pronouncing words accurately. It is plausible that online environments offer fewer speaking opportunities than face-to-face settings, along with reduced interaction and rapport-building [47]. Furthermore, many speaking assessments were conducted online during ERT, primarily through video submissions. While this format allowed students to plan and practise their presentations, the materials did not specifically focus on achieving engagement and persuasion for an online audience.

Table 3. Descriptive statistics—speaking subskills.

Difficulty	*N*	Minimum	Maximum	Mean	Std. Deviation
Using varied wording	113	1	5	2.71	1.107
Engaging the audience	113	1	5	2.73	1.086
Speaking persuasively	113	1	5	2.81	0.999
Referring to sources in presentations	113	1	5	3.04	0.939
Using stress and intonation	113	1	5	3.05	1.068
Speaking with confidence	113	1	5	3.12	1.310
Using a suitable spoken tone	113	1	5	3.15	1.054
Speaking fluently	113	1	5	3.18	1.128
Expressing myself clearly	113	1	5	3.19	1.048
Pronouncing words clearly and correctly	113	1	5	3.29	1.032

The students identified that the most challenging reading skill was finding suitable academic sources, followed by locating relevant information for essays. While students have access to the university's online database, they might have found the volume of literature overwhelming. Notably, library workshops—which are integrated into many language courses and guide students to use databases and search for resources—were not conducted face-to-face during this period. This could have made it difficult for facilitators to assist students who encountered issues. Paraphrasing and summarising information also presented challenges, a finding that aligns with the previous observation [26] that 'reading-to-write' is difficult even for higher-level students. Significantly, understanding academic or technical vocabulary posed problems for students, which can manifest in relation to various skills (e.g., reading, writing, listening). In contrast, skills such as scanning and skimming academic texts and comprehending their formats caused fewer difficulties, as students were able to transfer these skills from their secondary studies (see Table 4).

Table 4. Descriptive statistics—reading subskills.

Difficulty	*N*	Minimum	Maximum	Mean	Std. Deviation
Finding suitable academic sources	113	1	5	2.74	1.108
Finding relevant information for essays	113	1	5	2.78	1.050
Paraphrasing and summarising information	113	1	5	2.93	1.083
Understanding academic/technical vocabulary	113	1	5	2.94	1.063
Scanning and skimming academic texts	113	1	5	3.03	1.056
Understanding the format of academic texts	113	1	5	3.14	1.008

The participants indicated that listening was the least demanding skill. Lectures were conducted online and recorded, allowing students to review, pause, and replay challenging sections, which likely facilitated comprehension. However, the students found concentrating on lectures to be difficult (see Table 5). This could be attributed to the delivery style or distraction in their home environment. Students perceived understanding academic or technical vocabulary words and connecting their knowledge to the lecturer's content to be equally challenging. These difficulties have also been reported in face-to-face lectures, so they are not unique to the online environment [40]. The three least demanding listening subskills included catching up on the content of the lecture if they fell behind, keeping pace with the lecture's speed, and comprehending the lecturer's accent or pronunciation. These challenges may have been mitigated by access to recorded lectures.

Table 5. Descriptive statistics—listening subskills.

Difficulty	*N*	Minimum	Maximum	Mean	Std. Deviation
Concentrating on the lecture	113	1	5	3.43	1.164
Understanding academic/technical vocabulary	113	1	5	3.49	1.036
Connecting knowledge to what the lecturer says	113	1	5	3.49	1.103
Catching up with the instructor if falling behind	113	1	5	3.57	1.117
Keeping up with the speed of a lecture	113	2	5	3.85	1.071
Understanding the lecturer's accent or pronunciation	113	2	5	3.91	1.082

This study also investigated the challenges students faced in mastering study skills. Table 6 highlights that the most significant difficulties for students were a lack of motivation to study and managing their time effectively. These issues were likely exacerbated by limited face-to-face contact with peers, both informally and in class, due to COVID-19 restrictions. A blend of online and face-to-face learning opportunities may have motivated students. The participants also experienced difficulties with conducting research, searching for sources, and selecting and synthesising information. This suggests the need to incorporate relevant interventions into online EAP courses. In contrast, they considered planning for assignments, applying critical thinking skills, acting on feedback, and editing and revising their work less challenging. Students likely utilised editing tools to help finalise their assignments.

Table 6. Descriptive statistics—study skills.

Difficulty	*N*	Minimum	Maximum	Mean	Std. Deviation
Motivating yourself to study	113	1	5	2.77	1.118
Managing your time	113	1	5	2.85	1.087
Conducting research/searching for sources	113	1	5	2.89	1.047
Selecting and synthesizing information	113	1	5	2.94	1.020
Planning assignments	113	1	5	3.05	1.025
Using critical thinking skills	113	1	5	3.10	1.102
Acting on feedback	113	1	5	3.18	1.020
Editing and revising your work	113	1	5	3.19	0.962

Our analysis revealed no statistically significant differences due to gender or areas of study. However, we observed notable differences between students who primarily received their secondary education in English and those who did not, which are discussed in the following section.

4.2. The Effects of Previous EMI Experience

Table 7 presents the difficulties experienced by students based on their varying levels of English experience in secondary school. There were significantly fewer perceived writing difficulties among the 96 participants who were mainly taught in English ($M = 3.15$, $SD = 0.72$) than the 17 who were not ($M = 2.60$, $SD = 0.89$), $t(111) = 2.813$, $p = 0.006$, $d = 0.74$. The effect size for this analysis ($d = 0.74$) exceeded the established convention [48] for a medium effect ($d = 0.5$). However, an independent samples t-test revealed no significant differences in speaking difficulties between the students who were predominantly taught in English ($M = 3.09$, $SD = 0.87$) and those who were not ($M = 2.70$, $SD = 1.04$), $t(111) = 1.639$, $p = 0.104$, $d = 0.431$. Likewise, no significant differences emerged in difficulties with reading, $t(111) = 1.291$, $p = 0.200$, $d = 0.340$, listening, $t(111) = 1.755$, $p = 0.082$, $d = 0.462$, or study skills, $t(111) = 1.572$, $p = 0.119$, $d = 0.414$. Nonetheless, students with prior experience studying in English consistently had higher scores (i.e., less difficulty) than those without this experience. These findings are generally consistent with those of similar studies in face-to-face settings [35,44]. They show that it remains necessary to reach out to students with less EMI experience in online settings.

Table 7. Independent samples *T*-test for two groups of EAP students.

	Previous English Learning Experience (Mean ± SD)		*T*	Sig. (2-Tailed)
	Yes (*n* = 96)	No (*n* = 17)		
Writing	3.15 ± 0.72	2.60 ± 0.89	2.813	0.006 *
Speaking	3.09 ± 0.87	2.70 ± 1.04	1.639	0.104
Reading	2.97 ± 0.86	2.68 ± 0.92	1.291	0.200
Listening	3.69 ± 0.93	3.25 ± 0.98	1.755	0.082
Study	3.05 ± 0.88	2.68 ± 0.93	1.572	0.119

* $p < 0.05$.

5. Discussion and Conclusions

This study investigated EMI university students' difficulties with English writing, speaking, reading, listening, and study skills. While previous studies [9–11] identified writing as the most challenging skill, our participants found reading to be the most difficult skill to master, followed by study skills, speaking, writing, and listening. Notably, study skills, which have not been widely explored in similar studies, emerged as the second most problematic area for these students. Accordingly, study skills are an area of difficulty that should be given a more prominent role within EAP courses that prepare students for digital EMI settings. As in previous studies, vocabulary was particularly demanding, and students with less EMI experience faced difficulties with many of the skills, especially writing.

5.1. Study Skills and EAP Challenges

Many of the challenges students encountered were related to study techniques, self-organisation, and motivation. Motivating oneself to study was the most significant challenge related to study skills for the participants. Emotional struggles within online educational settings have been reported in other studies (e.g., [49,50]), and language difficulties likely exacerbate the psychological challenges among EMI students. Learners can adopt a range of strategies to cope with the frustrations they experience, including individual and cooperative emotion regulation strategies [51]. For example, they may engage in encouragement, increasing awareness (e.g., of tasks), task planning, and social reinforcement [52]. Previous studies [50] have recommended that online language practitioners foster a cooperative and transparent learning environment in which teachers and students negotiate their roles. Giving students the confidence to speak and contribute to the online learning environment is crucial for successful language learning.

5.2. Vocabulary Challenges

Students faced problems employing academic and technical vocabulary in their assignments, which is consistent with previous studies [35,51,53]. Challenges with vocabulary affected various subskills, including paraphrasing texts during reading, using synonyms during writing, and using varied wording in speaking tasks. Taking EMI courses online may exacerbate these challenges because they provide students with less direct contact with lecturers and peers, as well as fewer opportunities to ask questions.

To address these issues, online EAP courses should emphasise the strategies and tools students can use to learn vocabulary. In addition, course designers could develop assignments in which students use discipline-specific terms in addition to general academic terms. EAP teachers and lecturers in the disciplines could collaborate to produce vocabulary lists and techniques for mastering vocabulary. Though EMI courses are generally seen as content-focused, lecturers could be encouraged to take the time to highlight and explain key terms. Raising awareness about students' experience with EMI courses through professional development could also help subject-matter lecturers understand the linguistic challenges students face.

5.3. Supporting Students with Lower English Proficiency

One major implication of this study is that it is necessary for online EMI instructors to reach out to students with lower levels of English proficiency, who may be less confident and willing to communicate during online classes. In this study, an independent variable—whether students were taught most of their secondary school classes in English—had a significant influence on the perceived difficulty of various skills, similar to studies conducted in face-to-face settings [11,35,36,53]. To assist struggling students in adapting to the English environment, university language centres can provide targeted small-group teaching. Providing these students with mentors, in particular, could provide them with a personalised and low-pressure environment in which they can gain insight and confidence [54,55]. Structured group work with clear roles and regular virtual student–teacher conferences can also promote active learning and elevate the learning trajectories of struggling English users. Those who develop EAP materials could also consider producing microlearning resources such as infographics (e.g., [56,57]), which can summarise key learning points in visually appealing ways and support students as they work on assignments. Finally, EAP teachers can help develop students' reading skills when delivering content online by integrating technology such as brainstorming tools (e.g., wikis, Miro) to help students understand texts and generate new ideas for later writing tasks.

5.4. Limitations and Future Research

This study gauged the needs of online students taking EMI courses using a self-reported questionnaire, finding that reading and study skills were particularly demanding. Although incorporating qualitative data would allow for further exploration, many of our findings should resonate with EAP practitioners who help students deal with such challenges. More studies are required to confirm whether reading and study skills are the most prominent challenges faced by other cohorts of students or those in other contexts. With the increasing popularity of EMI and the widespread adoption of online higher education, EAP support will continue to be crucial in assisting students in their learning pursuits. Despite these challenges, online EAP courses have significant potential. We hope that the results of this study will help guide EAP practitioners and course developers in Hong Kong and beyond.

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Appendix A. Questionnaire: Developing English for Academic Purposes (EAP) Provision

Section I—Demographics

1. What is your gender?

   Male
   Female

2. What is your year of study?

   Year 1
   Year 2
   Year 3
   Year 4

3. What is your Faculty?

   Faculty of Applied Science and Textiles
   Faculty of Business
   Faculty of Construction and Environment
   Faculty of Engineering
   Faculty of Humanities
   School of Design
   School of Hotel and Tourism Management

4. Did you study the majority of your secondary school subjects in English?

   Yes
   No

Section II—Writing Difficulties

5. Reflecting on your university studies, how difficult are the following skills?

Writing	1 = very difficult	2 = difficult	3 = neutral	4 = quite difficult	5 = not difficult
Citing sources correctly					
Using academic/technical vocabulary					
Using synonyms/a range of vocabulary					
Expressing your ideas clearly and concisely					
Using Appropriate essay structure					
Using an appropriate tone/formality					
Producing grammatically correct sentences					
Writing critically/evaluating ideas from sources					

Section III—Speaking Difficulties

6. Reflecting on your university studies, how difficult are the following skills?

Speaking	1 = very difficult	2 = difficult	3 = neutral	4 = quite difficult	5 = not difficult
Having clear and correct pronunciation					
Using stress and intonation					
Speaking with confidence					
Speaking fluently					
Engaging the audience					
Using a range of language					
Referring to sources in presentations					
Expressing yourself clearly					
Speaking persuasively					
Using a suitable spoken tone					

Section IV—Reading Difficulties

7. Reflecting on your university studies, how difficult are the following skills?

Reading	1 = very difficult	2 = difficult	3 = neutral	4 = quite difficult	5 = not difficult
Finding suitable academic sources					
Understanding the format of academic texts					
Finding relevant information for your essays					
Understanding academic or technical vocabulary					
Scanning and skimming the academic texts					
Paraphrasing and summarizing information					

Section V—Listening Difficulties

8. Reflecting on your university studies, how difficult are the following skills?

Listening	1 = very difficult	2 = difficult	3 = neutral	4 = quite difficult	5 = not difficult
Understanding lecturers' accents or pronunciation					
Keeping up with the speed of a lecture					
Concentrating on the lecture					
Catching up with the instructors' talk if you fall behind					
Understanding academic/technical vocabulary					
Connecting your knowledge to what the lecturer is saying					

Section VI—Study Skills Difficulties

9. Reflecting on your university studies, how difficult are the following skills?

Study skills	1 = very difficult	2 = difficult	3 = neutral	4 = quite difficult	5 = not difficult
Planning for your assignments					
Managing your time					
Conducting research/searching for sources					
Selecting and synthesizing information					
Using critical thinking skills					
Editing and revising your work					
Acting on feedback					
Motivating yourself to study					

Section VII

10. What other difficulties do you have in your studies?

(open ended)

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Investigating Online versus Face-to-Face Course Dropout: Why Do Students Say They Are Leaving?

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Abstract: Despite more focused attention in the wake of the COVID-19 pandemic, high online attrition remains both a concern and a mystery; gaps in our knowledge exist as to why students so often do not complete online courses. Pre-pandemic, and using a sample of 780 students who dropped out of fully online courses (or the same course face-to-face) from a large university system in the Northeast U.S., students were explicitly asked about their specific reasons for course withdrawal. All students enrolled in a fully online course (or a face-to-face section of the same course) at the City University of New York (CUNY) in fall 2015 were invited to take the online survey from which this study data was taken. Results indicate that there were distinct differences in the patterns of reasons given by online and face-to-face students: although the perceived quality of the instructor/instruction was deemed important to student persistence in both modalities, it seemed to be of greater importance face-to-face than online. Furthermore, issues related to time were found to be more prominent reasons for dropping for online learners than face-to-face learners. Findings from this study shed new light on the impetus for online attrition, with implications for online policy and course design in a post-pandemic era.

Keywords: post-secondary education; adult learning; online learning; course dropout; time poverty

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1. Introduction

Notwithstanding continued pre-pandemic growth in the adoption of online learning in higher education for more than a decade [1] and the almost universal move to Emergency Remote Teaching (EMT) in the U.S. during the height of COVID-19 [2], the impact that online enrollment may have on college persistence and degree attainment remains unclear. Research from prior to the onset of the pandemic shows that online courses may provide increased access to college [3], and there is support that students can learn as much online as they do face-to-face via comparison of course-level factors (see review in [4]). However, studies are mixed as to the outcomes for those who choose to enroll online, with some multi-institutional studies [5–7] finding negative impacts on college persistence. Other multi-institutional studies [3,8] and a nationally representative study [9] found no differences in retention or graduation rates between those who engage in online learning and those who engage in face-to-face learning.

While the impact of voluntary online enrollment on college outcomes such as persistence and degree attainment may be uncertain, what does seem to be supported by pre-pandemic research is that online courses often have higher dropout rates than face-to-face courses (see [4,10–12] for reviews). The issue of higher dropout in online courses

continues to raise the concern that online course enrollment might hinder degree completion; course withdrawals are considered to be a significant variable in student success [13]. However, online students have different characteristics than face-to-face students, and thus higher course dropout online, when it exists, may be related to demographic and environmental variables that prompt students to enroll online in the first place. For example, online students are more time-poor, and this has been linked to lower retention and credit accumulation [14].

While online attrition has been linked by some research to academic non-success (see [4]), in other cases it may be a reasonable response to a rational cost-benefit analysis; Diaz [15] theorized that students may choose to drop online courses in order to meet their immediate personal or long-term academic goals (for example, a student might drop because they determine that they have insufficient time for the academic work needed to obtain their desired course grade; as students who choose to take courses online are more time-poor [4,16], this may happen more often in online courses). Twenty years after Diaz's theorizing, we still do not have a complete understanding of what motivates online students to drop out (and in turn, how best to implement interventions to better retain them). Given that almost three quarters of higher education administrators noted online learning as critical to their future strategic plan pre-pandemic [17], and that higher education online administrators recently sampled across the U.S. predict that by 2025, most higher education learner experiences will include online learning [18], more knowledge about why those who voluntarily enroll online may choose to drop out seems critical.

2. Literature Review

2.1. Rise of Online Learning

Pre-pandemic, the number of students studying on-campus in the U.S. dropped by over one million from 2012–2016; at the same time, enrollments in online learning increased for fourteen years straight, and almost a third of all post-secondary students enrolled in at least one online course annually [1,17,19,20]. By the fall of 2020, after the onset of the COVID-19 pandemic, 75% of all undergraduate students in the U.S. were enrolled in at least one online course [21]. Prior to the pandemic, not all students elected to enroll in online courses, and as we move into a post-pandemic era, students will again be able to choose whether or not to voluntarily enroll online [4]. Data today suggests that student interest in online learning is currently higher than it was pre-pandemic, and that higher education institutions will likely continue to invest more in online programming to meet student demand [18,22].

2.2. Online Learning and Attrition

Research indicates that many who take online courses (outside of pandemic-induced necessity) do so because they need the flexibility that these courses offer due to a wide range of life challenges that make it difficult to attend face-to-face courses [23–30]. However, what is currently empirically unknown is the specific reason that prompts these same students to drop out of their online courses; most studies instead focus on the behaviors of students who persist online [31]. Attrition rates among online learners fluctuate between 40–80% [32], and these rates may be increasing [11,31]. At least twenty-five studies over almost two decades conducted prior to the pandemic report that online dropout rates are consistently and significantly higher than dropout rates for face-to face courses, with online attrition appearing to be 7–20 percentage points higher than the attrition found in face-to-face courses (see reviews in [4,10]). However, why more students drop out online in comparison to face-to-face is uncertain [33].

Studies often assume that higher rates of dropout in online courses are the result of features of the online environment itself [6,7]; however, student self-selection into online courses makes it difficult to tease apart whether student reasons for dropout are related to the online medium itself (at least in terms of how it is typically currently implemented), or other characteristics or environmental factors in the lives of the students who elect

to take courses online [14,34]. Students who choose to enroll in online courses have different characteristics than those who enroll only face-to-face: for example, they are more likely to be older, with work and family responsibilities, and are on average more time poor [14]. Thus, students who choose to enroll in online courses may have reasons for dropping that are different on average from students who enroll in face-to-face courses, but existing research has not directly compared student reasons for dropout in both mediums side-by-side.

2.3. Online Learning and Student Satisfaction

A body of research has investigated the perceptions of students and their "satisfaction" with online learning, although this literature focuses on completers rather than those who drop out of online courses. Course design/quality has been implicated as a critical—perhaps the most important—factor influencing completer's satisfaction with online learning; other factors include the learner's motivation and time management, and their comfort with technology [11,12,35–37]. Furthermore, instructor presence (i.e., feedback and interaction) is often cited as important for students who report being satisfied with online learning experiences, as well as the quality of peer interaction and whether the course is a match with individual learning styles [38–42]. This research provides useful knowledge about what influences the satisfaction of online completers, and may in turn provide some clues as to why unsatisfied students drop out, as research suggests that online learners are less likely to drop when they are satisfied with their courses [12,43]. However, it does not necessarily follow that all of the same factors in the completer satisfaction literature influence decisions to drop out of online courses, or which factors, if they influence these decisions, are of the most importance for non-completers.

2.4. Persistent Knowledge Gap—Why Do Online Students Drop?

Even though the question this study addresses originated 20 years ago, the reasons why students drop out of online courses continues to remain under-researched; very few studies have attempted to give students a voice by actually asking them why they drop. In a meta-review spanning 1999–2009 [44], only seven empirical studies were identified that specifically sought students' reasons for dropping out of online courses. One of these, [45] found that 10 masters-level students dropped out online due to work-related reasons, personal issues (i.e., lack of time; family responsibilities), course reasons (course workload/course difficulty), and technology difficulties. The other six empirical studies noted in the Lee and Choi review also report some combination of these explanations for students dropping out, with instructional design issues and time-related issues related to work and family implicated the most often across the studies. However, all these studies are decades old, and they had very small and homogenous samples (in terms of the number of students and only one/few online courses sampled), likely resulting in selection bias [44], which severely limits their generalizability.

In a larger study, Fetzner [46] reports data from telephone surveys of unsuccessful online students at a single college (n = 438); she found that when asked to select from 22 statements, the top three reasons for dropping an online course selected by students were: could not catch up/ falling behind in coursework (19.7%), personal problems (health, job, childcare) (14.2%), and could not handle combined study plus work/family responsibility (13.7%). However, Fetzner also noted that the sample was not representative of the college population, and particularly was under-representative of "Blacks and other ethnicities and first-time online students" (p. 16). This study also studied online course dropout in isolation, without a comparison group of students enrolled in face-to-face courses, so it is unclear the extent to which these reasons for dropout are specific to students enrolled in online courses specifically, or just courses in any medium.

While scholars have given considerable effort to being able to better predict dropout, students' voiced reasons for dropping out remain somewhat ignored by the online literature as a whole; Xavier and Meneses [31] assert that more qualitative data is needed to probe

students' real-life experiences and the multiplicity of factors that may impact their decisions to drop out. There are significant limitations of scale and potential generalizability in the few early online studies about why students drop online courses. There is also a scarcity of larger and more recent studies that focus on students' voiced reasons for dropping out, rather than summarizing the characteristics of those who drop or persist. Furthermore, we know of no studies in any of the literature that utilizes our specific method of comparing student reasons for dropping out in matched online versus face-to-face courses to directly compare reported reasons for dropout. However, this is necessary if we are to distinguish which factors may be specific to online courses (or the students who take them) versus which factors are pertinent to general course dropout regardless of medium.

3. Conceptual Framework

Currently, there is no empirically validated model for online retention; the few models available [47–50] have not been widely tested and may exclude important factors [4]. However, there are substantiated models of retention for face-to-face students. Tinto's widely cited model [51–53] posits that family background, pre-college schooling, and individual student attributes influence student persistence through two "integration" variables: (1) academic integration (e.g., often measured by G.P.A.); and (2) social integration (e.g., interaction with peers/faculty). In a similar vein, Bean and Metzner's model [54] is widely cited and specifically examined "non-traditional" adult learners. This model contains three main input categories: environmental, academic, and background, and these variables then influence academic and psychological outcomes, which in turn determine a student's decision to persist. The emphasis of Bean and Metzner's model on "non-traditional" students makes it more likely to be relevant for online students, as the data show that most students who enroll in online courses have "non-traditional" characteristics [6,7,9,33,55–59].

Rational choice theory [60], which avers that students make educational decisions based on the costs, benefits, and probability of successful outcomes, may help explain why some college students choose to drop out of online courses. As it is not possible for students to consider all potential consequences of course dropout because of limitations in current knowledge and factors that may play out in the future, we do not assume that students are perfect rational decision-makers. Instead, we use the concept of bounded rationality [61]. In line with this, Diaz [15] contended that the mere fact of high online drop rates is not necessarily indicative of academic non-success; it may instead reflect a mature decision on the part of students who also have different characteristics than face-to-face students. There is strong evidence that students who choose to enroll in online courses and are more likely to be: female, older (e.g., over 24 years old), employed and financially independent, married with children, and with other life responsibilities [3–7,9,58,59]. Moreover, these student characteristics have been connected to higher rates of time poverty (i.e., not enough quantity of time and high-quality time to engage in academic studies), which has been shown to mediate course/college outcomes [14,16,34,62–64].

Therefore, life factors and issues related to time may greatly contribute to student dropout of online courses. Thus far, the issue of time as a potential dropout factor, while noted by scholars for decades, has been largely ignored in studies and models of online attrition [14,16,31]. It may be that student demographic characteristics (i.e., woman, parent, student of color) that lead to more prevalent environmental factors (higher amount of work, lack of childcare, other family responsibilities) have served as both the impetus, and predictive proxies in studies, for the underlying issue of time poverty [14,16]. As our study focuses on the motivation for drop out (rather than retention), we postulated an a priori model of online dropout based on Bean and Metzner's [54] model, the scant online dropout literature available, related work on online satisfaction and persistence (i.e., [11,12,35,39–42], and related research on time poverty and online learning [14,16,34,62] (see Figure 1).

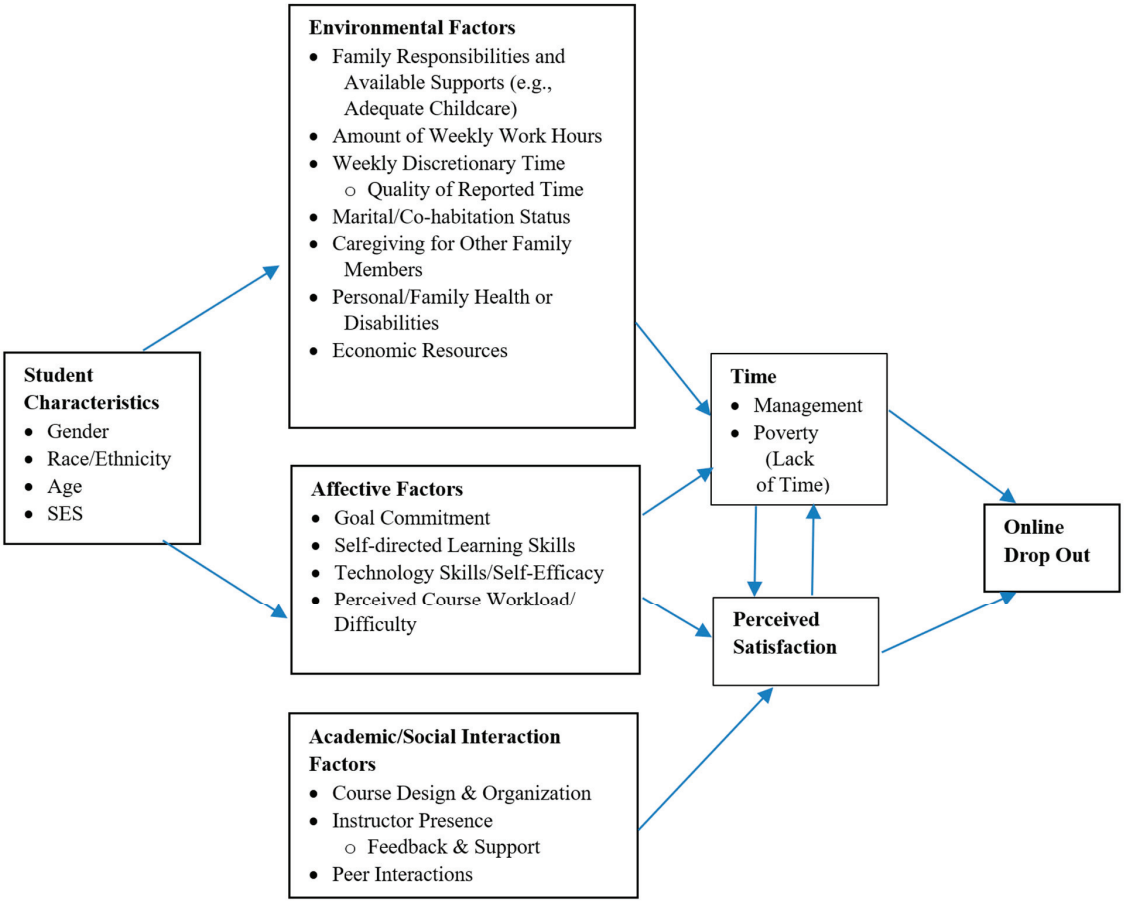

Figure 1. A priori Model of Online Dropout.

4. Research Objective

The goal of this study was to test and refine the model of online student dropout posited in Figure 1, by determining the extent students cite these factors, or others, as playing a role in their decision to drop out of college courses. In particular, by comparing the responses between those who withdraw from online vs. face-to-face sections of the same courses, we hoped to elucidate any factors that may be unique (or more pervasive or significant) for online learners, such that specific interventions may be employed in higher education to ameliorate these for online dropout in the future. Therefore, in this study, we asked:

What are the reasons postsecondary students give for dropping out of online courses, and how do these reasons compare to reasons given by students in comparable face-to-face classes?

5. Method

The City University of New York (CUNY) system is the third largest university system in the U.S., and the largest public urban university in the U.S. [65,66]. Data analyzed for this study were taken from existing survey data. All students at the two- or four-year colleges at CUNY who were either enrolled in a fully online or face-to-face section of any course that offered sections in both mediums were invited via email to take an online survey during

fall 2015. Students were sent multiple email reminders, and the response rate (18%) was double that of official surveys at the university [67]. This resulted in 22,410 responses, and sample analysis indicates that this sample is roughly representative of the larger CUNY population. In this survey data, a total of 780 students dropped out; of these, 702 provided their reasons for dropping (response rate of 90%).

While definitions of "dropout" vary in the literature [44], we operationalized dropout (used interchangeably with the term withdrawal in this article) as formally or informally (by stopping attendance) withdrawing from a course at some point in the semester. Students who dropped a course were asked about their reasons for leaving in the survey. In this study, we analyze students' written responses explaining why they dropped the course.

Courses in this study are classified as fully online if 80% or more of the course is conducted online. Courses are classified as face-to-face if less than 20% of the course is conducted online. (Courses that fell in between these two ranges were denoted as hybrid; these courses were excluded from the study to make the distinction in course medium distinct and to allow for a clear-cut comparison of the data.). We note that online courses at CUNY (as well as more generally [68]) prior to the COVID-19 pandemic were mostly asynchronous; thus, the results of this study are specific to comparisons of asynchronous vs. face-to-face courses.

The overall goal was to investigate the motivation for students' decisions to withdraw from their courses. Student responses to the same survey, given to a different sample the prior year, were analyzed and then used to develop a coding frame which was then applied in this study; we employed a thematic analysis method adapted from Joffe [69] within the software QDAMiner 6. To develop the coding frame, pilot study data were analyzed through a four-part process, including: (1) a general review to familiarize researchers with the data; (2) open coding to generate all possible raw code units while drawing from previous dropout research and an inductive reading of the responses, (3) categorization of similar/related code units under initial themes, and (4) generation of themes by refining and naming. To ensure rigor during the coding frame development process, the collected pilot study data were examined by three researchers independently. Three different coding schemes were initially developed from the pilot data; these were compared for interrater reliability, and cases with discrepancies were resolved through discussion and consensus.

The coding frame developed from the pilot study was then used to conduct a thematic analysis on the responses generated in this study. For this study's data analysis, each student response was coded by two coders. After the first round of coding, inter-rater reliability, as measured by Krippendorf's alpha (measuring the presence/absence of each code for each student) was 0.71 for individual sub-codes and 0.85 for larger theme categories. After this round, coders went through a round of norming; many cases of disagreements involved subtle distinctions (e.g., one coder may have selected "teaching style did not fit student learning style" while another may have coded "quality of instructor"); to resolve this, codes in the coding frame were more carefully defined to distinguish them from one another. After the second round of coding, inter-rater agreement as measured by Krippendorf's alpha was 0.98 for individual codes and 0.99 for larger code categories (See Figure 2).

General trends were explored for all codes in the coding frame, including those that were cited by only a small number of students. However, when calculating and comparing the percentages of students in each instructional medium who selected particular codes, the findings reported here were limited to only those themes that were indicated by at least 20 students.

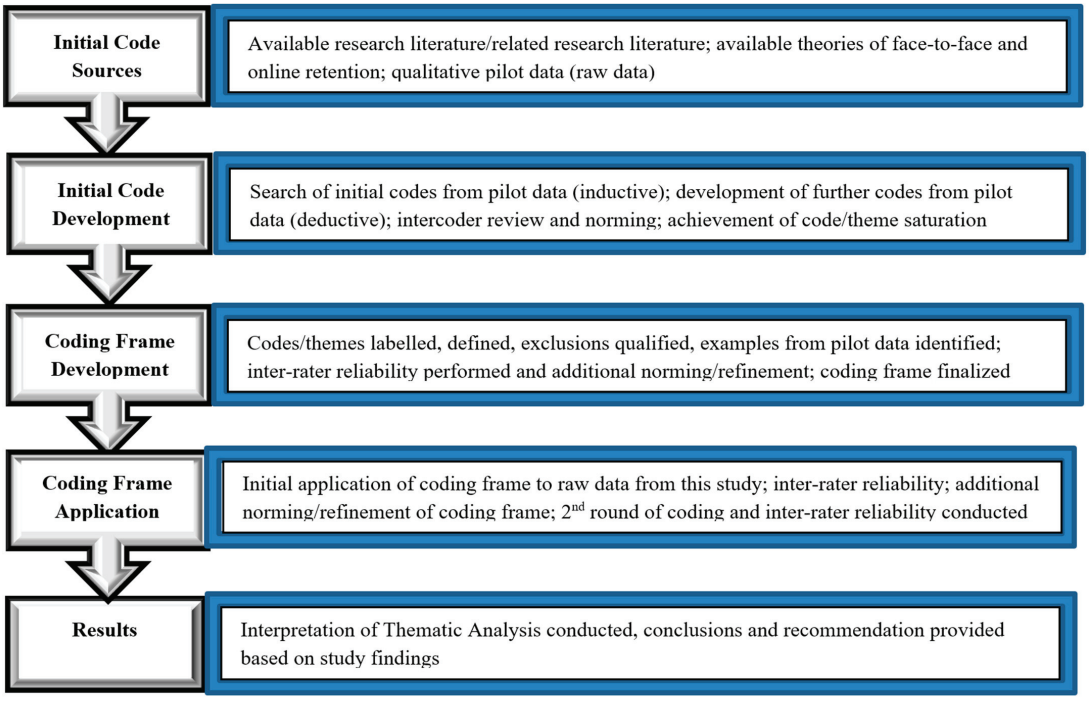

Figure 2. Process of thematic analysis code frame creation and application in this study.

6. Results and Discussion

6.1. General Findings

For both types of students (online and face-to-face), three main themes for dropping a course were indicated in the data. Course characteristics were the most named reasons for withdrawal across modalities; the most cited sub-codes were the quality of the instruction/instructor in the course and course workload/difficulty. Issues related to a lack of time was the next most given motivation for dropping a course provided by both sets of students (specifically, they noted paid work; family commitments; personal time commitments; and other academic demands on time). Finally, the third most cited reason for dropping out of online or face-to-face courses was course performance (i.e., grade at the time of drop).

Web and Cotton [70], who recently researched why students contemplate dropping out generally (nonspecific to course medium), similarly found instructor interactions and workload as significant motivating factors, although unlike in our results, they note financial concerns as the main reason. Financial concerns, not found in this study as a major consideration, have also been found to be a consideration for online course dropout and the main reason for college attrition more generally [71,72]. Although not as high as the other reasons given, a notable proportion of students in both modalities cited course performance as a reason for dropping out at almost identical rates, suggesting that protecting overall G.P.A. may be equally motivating in prompting dropout for both online and face-to-face students. We note that recent research by Akos and James [13] indicates that while course withdrawal may allow students to protect their GPAs at that specific point in time, it may also result in academic disengagement and increased later general college dropout.

While the three main themes for course withdrawal were similar in order across course modality, a deeper look at the data shows that there were some distinct differences in the patterns between modality for students' decision to withdraw from their courses (See Table 1). Results indicated that online students were significantly more likely to cite course characteristics as their motivation for dropping out in comparison to face-to-face students.

We note that course characteristics as the main reason for dropping an online course is consistent with some past online research on student satisfaction [11,12,35–37]. In addition, online students were much more likely to indicate lack of time as their reason for dropping out in comparison to face-to face students; this is in line with early studies reviewed by Lee and Choi [44]. In contrast, face-to-face students indicated financial issues, not needing the particular course anymore, or a feeling of not fitting in/belonging at higher rates in comparison to online students as their reasons for leaving.

Table 1. Reasons for course withdrawal by course medium—general trends.

	Fully Online	Face-to-Face	*F*-Test	*p*
course characteristics	65.3%	49.7%	7.2	0.007
lack of time	44.9%	36.7%	3.16	0.076
money/resources	1.0%	4.9%	2.69	0.101
no longer need this particular class for degree	1.0%	3.2%	1.26	0.262
fit/belonging	1.0%	2.6%	0.73	0.392
class performance	21.4%	22.0%	0.07	0.798

Percentages indicate proportion of students who gave responses that were coded at least once with a given code.

Since online and face-to-face students cited both course characteristics and lack of time at very different rates, we further analyzed these themes by exploring the specific response patterns. To visualize the differences in patterns of reasons given by students enrolled in online versus face-to-face courses, graphs were generated (See Figures 3 and 4). The figures show the commonalities between modalities (e.g., quality of instruction/instructor is by far the most noted dropout motivation across both types of students). The figures also highlight differences between student types (e.g., factors related to time and course workload are much more cited issues motivating course withdrawal for online students in comparison to face-to-face students). Subsequent investigations were conducted to delve deeper into these differences observed between student types.

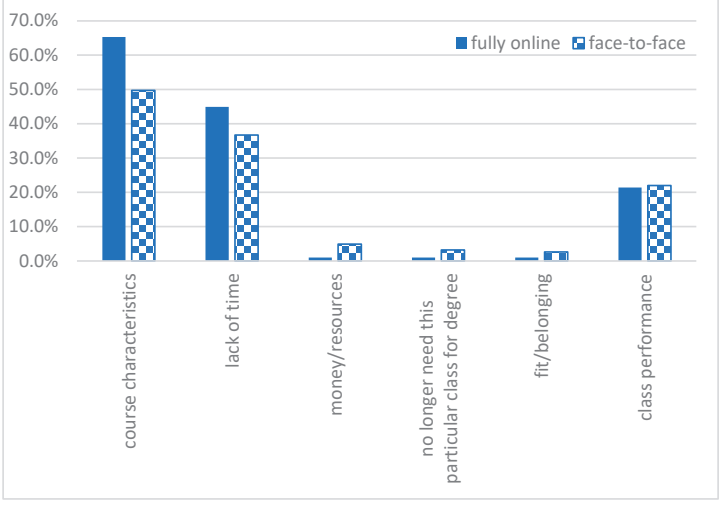

Figure 3. Graph of face-to-face vs. online course dropout motivation.

6.2. Course Characteristics

Table 2 presents the detailed pattern of course characteristic sub-codes that were cited by students in online versus face-to-face courses. While quality of instruction/instructor was the most commonly cited reason students in both types of courses withdrew, face-to-face students cited this at significantly higher rates than online students. Moreover, online

students cited course workload and course difficulty as the next most prominent course characteristic reasons for dropping out, and at significantly higher rates than face-to-face students. Significant differences in the proportion of responses between student type was also observed for four other sub-codes: instructional modality did not fit learning style; quality of instructional materials; understanding of instructor expectations; and quality of peer interactions, with online students citing all of these at significantly higher rates.

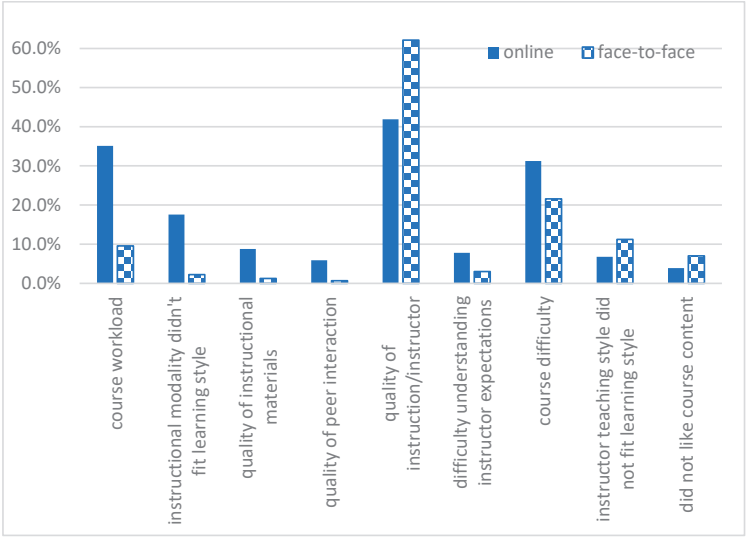

Figure 4. Graph of face-to-face vs. online course dropout reasons related to course characteristics.

Table 2. Reasons for course withdrawal by course modality—course characteristic sub-codes.

	Online	Face-to-Face	*Z*-Score	*p*
course workload	35.1%	9.6%	7.01	0.000
instructional modality did not fit learning style	17.6%	2.2%	6.99	0.000
quality of instructional materials	8.8%	1.2%	4.76	0.000
quality of peer interaction	5.9%	0.7%	4.09	0.000
quality of instruction/instructor	41.9%	62.1%	−3.59	0.000
difficulty understanding instructor expectations	7.8%	3.0%	2.37	0.024
course difficulty	31.2%	21.6%	2.12	0.042
instructor teaching style did not fit learning style	6.8%	11.2%	−1.32	0.093
did not like course content	3.9%	7.0%	−1.17	0.121

Percentages indicate proportion of students who gave responses that were coded at least once with a given code.

6.2.1. Quality of Instruction/Instructor

Most student responses were identified as issues of instructor/instruction quality, regardless of modality. The majority of the comments on what a lack of quality entailed found in the data were related to either a lack of organization or unresponsiveness of instructors (including unwillingness to answer questions):

- *The professor I had was very unorganized and was not clear with the content.*
- *The professor was not very helpful, to be very honest. Furthermore, his teaching style was very unorganized and thus, I had a hard time following along.*
- *The professor did not respond to emails, and the style of teaching was not clear to me.*
- *I did not get any feedback from my professor when I asked for help.*

This finding is consistent with recent research by Glazier and Harris [73], who also found that having instructors who are engaged and available matter to students regardless of instructional modality.

While comments on a lack of instruction/instructor quality were the most cited reason for course withdrawal across modalities, there were specific trends in student responses related to instructor/ instruction quality that were only found in the descriptions of face-to-face students. These trends may help explain why face-to-face students cited this specific reason at significantly higher rates than online students (55.9% vs. 33.7%). A closer look at face-to-face student comments suggests that this difference is likely due to the quality of face-to-face interactions and oral lectures. Many face-to-face students denoted professors as rude or disrespectful, and furthermore, many cited class lectures that were off-topic or that were poorly explained. In conjunction, common among the responses were descriptions of how face-to-face instructors would not answer questions or became angered when questions were asked:

- *The professor I took did not do a good job in lectures and he was extremely rude and did not care about the students at all.*
- *The professor did not know how to properly teach the class, as well as not staying on task.*
- *The material was not taught well and the professor ridiculed the student for asking any questions.*
- *The instructor was not explaining the work, and whenever the class had a question, the instructor would yell at the class. The instructor was no help at all!*

This may point to a need for professional development of face-to-face instructors who rely on in-the-moment oral lectures to convey course materials, as past research identifies key elements (chief among these organization and clarity) of a highly effective in-person lecture [74]. However, there are other possible interpretations, such as instructor self-selection: some instructors have reported teaching practices becoming more prepared after working with instructional designers and devoting time and effort to development of online courses [75]. Further still, the ability to record and edit lectures for online viewing (compared to the spontaneous nature of face-to-face lecturing) or other means of multi-media may have alleviated this issue for online students; some research suggests higher student satisfaction (although not necessarily less dropout) with access to recorded lectures [76]. Future research is needed to assess this in relation to course withdrawal between student types.

While similar lecture descriptors were not present in online student responses, there were other similarities: specific online student comments regarding instructor/instructor quality tended to refer to a lack of instructor communication/responsiveness as a driving motivation for course withdrawal, which was also a common theme among face-to-face students. This is consistent with Glazier and Harris [73], who note that a lack of instructor engagement may hurt online students' satisfaction more than it hurts face-to-face students' satisfaction. It further supports a plethora of online social presence research (e.g., see review in [11]) noting the critical importance of high amounts of contact and timely and high-quality feedback from instructors in facilitating academic understanding, as well as a sense of belonging in the online environment.

Thus, we saw that a lack of instructor engagement and responsiveness appeared to be a critical reason for student dropout in both mediums, but that dissatisfaction with lectures was a recurrent theme in face-to-face courses but not online. This may suggest that online asynchronous courses frequently use different types of instruction, rather than relying primarily on lectures, or that lectures, when used in online asynchronous courses, may tend to be more well organized due to the fact that it has to be prepared and recorded in advance. This could be a productive area to explore further in future research.

6.2.2. Course Workload and Course Difficulty

While course difficulty was the second most cited reason for dropping for face-to-face students, course workload was the second most cited reason given by online students.

More critically, the data showed that online students were significantly more likely in comparison to face-to-face students to cite course difficulty (28.1 and 19.4%) and course workload (31.6% vs. 8.6%) as a reason for dropping their courses:

- *Workload for an online class was too much. And the times for the due dates were not helpful. Lack of time.*
- *I found the class hard to keep up with. The readings were intense and in heavy amounts. The assignments were every week and it was just too much.*
- *The course was really time consuming… Everyday there was something new and if you were lost in one chapter you will not be able to pass.*
- *The workload required for this course was overwhelming. Aside from assigned reading assignments that equated to a face-to-face course class time, the homework and assignments required a great amount of additional time.*

This confirms previous research [45] that indicates that online students will drop their courses if the course workload is perceived to be too hard. However, what is interesting about online students' comments on course difficulty and course workload is that when looking closely at their specific statements, these often tended to be related to students' time, in addition to, or even in some cases instead of, the actual quality of the course design. This may support Pierrakeas et al. [77] and Leeds et al. [78], who note that a miscalculation/under-estimation of the time required for completing the online workload influenced students' decisions to withdraw. Alternatively, it may be that some instructors who teach online courses design their online courses in such a way that they are actually more difficult or have a higher workload than their face-to-face sections; for example, to counter stigma often associated with online courses [79,80]. To our knowledge, there are no studies available that have investigated this possibility. It is also possible that students enrolled in online courses perceive their courses to be more difficult or the workload to be higher precisely because they suffer from more time poverty on average than comparable face-to-face students [16]. More research is needed to better understand what contributes to student perceptions of course workload and difficulty online.

6.2.3. Instructional Modality and Learning Style

Only 2% of face-to-face students identified that a poor fit between instructional modality and their learning style was a reason for their course withdrawal, in comparison to 15.8% of online students who provided this reason; this difference in motivation for dropping the course is significant:

- *I felt I was not understanding the material as fully as I would have in a classroom.*
- *I could not follow the online class, the material is complicated. I think the course should be face-to-face.*
- *It was very challenging for me, and I feel as though I will have to take the course in a classroom setting.*
- *I found myself distracted and overwhelmed and even more isolated… I WOULD NEVER TAKE ANOTHER ONLINE CLASS.*

The students who gave these kinds of responses may reflect a genuine lack of fit between their own learning style and the asynchronous online course design (the typical online course design at CUNY prior to the pandemic); learners may have specific preferences or predispositions to perceive and process information in a particular way/combination of ways, and this may not always match the ways that online instructors present content [81]. Alternatively, the fit issue may be less about the medium and more about course difficulty. At a closer look, many of the online student responses seemed to relate to the difficulty of the content/subject of the class; findings from Jaggars [82] suggest that students prefer to take "easy" subjects online and "hard" or "important" subjects face-to-face. Thus, responses related to the online medium not fitting student learning styles may be related to the earlier identified issue of a connection between perceived course difficulty and online course dropout.

6.2.4. Quality of Online Materials and Instructor Expectations

There were significant differences in reporting quality of instructional materials and a lack of understanding of instructor expectations as the reasons for course withdrawal. Specifically, online students were much more likely to say that they had dropped the course because of the quality of instructional materials (7.9% vs. 1.1%) and because they could not understand the instructor's expectations (7% vs. 2.9%):

- *My professor was not clear enough on her syllabus. . . what the class will be like and what would be expected from us.*
- *Questions were not formatted properly and it was hard to understand what she was asking for.*
- *Found it difficult to understand the professor's announcements.*
- *The instructor decided to use another website for the assignments and I was all over the place.*

This is consistent with Glazier and Harris [73], who note that online students expressed greater concern about course organization and quality of assignments in comparison to face-to-face students. It also supports previous research reporting vague expectations and problems with online course materials, and that findability/quality of instructional materials are critically important (see review in [11]). Additionally, some recent research suggests that online students care deeply about the quality and quantity of online materials, whereas instructors may not focus on this, assuming whatever is provided is sufficient [72]. It is unclear the extent to which online materials were actually more poorly crafted than face-to-face ones. In an online asynchronous course, it may be that *all* interactions with the professor are perceived to be a type of "course material", and this may be one reason why this category occurred more often with online students. Furthermore, the clarity of written instructions may be more important in asynchronous online courses in comparison to face-to-face courses, as this may be seen as a form of instructor presence in this modality [73].

6.2.5. Quality of Peer Interactions

We note that the low rates of citation of quality of peer interactions as a motivation for course withdrawal is surprising, as social integration with peers has been deemed a critical retention factor in previous research across modalities (see reviews in [11,72]). Furthermore, the quality of peer interactions has been found to be a major reason that online students contemplate dropping out [70]. Even though this reason was cited at lower rates than other motivations for course withdrawal, the data does show that online students in comparison to face-to-face students were significantly more likely to cite the quality of peer interactions (5.3% vs. 0.6%) as the reason for dropping their courses:

- *I was forced to do group work. My group members did not want to do anything and when I emailed the professor about it, he told me to deal with it. I dropped because I was not putting my grade in the hands of lazy classmates. . .*
- *. . .the issue that a "classmate" was literally copying my post on the discussion board and I was not getting credit for it. . ..*

The data seems to corroborate previous research that suggests that online students are not in favor of group assignments without instructor support [83], and that instructor facilitation is critical to structuring meaningful peer-peer interactions (see review in [84]). Furthermore, our findings support the idea that online students may find instructor-student interactions more important than student-student interactions [85]. There is an entire body of research about building learning communities online through online collaboration and discussion (see reviews in [72,78,84]). However, this as a protective factor against student withdrawal may depend greatly on instructor facilitation in the online environment; this bears further investigation.

6.3. Issues of Time/Time Poverty

In addition to course characteristics, issues related to time were also highly prevalent as reasons for dropping out online and face-to-face, with almost half of all online students citing this, and over one-third of all face-to-face students giving this as a reason

for dropping out; the difference in these propositions online vs. face-to-face was significant. Time constraints are an oft-reported reason for enrolling online in the first place (e.g., [23,25,27–29]). We have posited that the same time constraints that make some students more likely to take online courses may be the same reasons that make them drop out [14,16,34]. Results from this study suggest some support for this notion, as issues related to time were found to be more prominent reasons for dropping for online students than for face-to-face students (45% vs. 37%).

To tease apart specific responses related to time, Table 3 presents a detailed breakdown of the cause of the time limitations that were cited by students enrolled in each course medium. The largest proportion of time-related-reasons for course withdrawal in order of prevalence fell into the following sub-codes: personal time commitments, work, family, and other academic demands; this order of prevalence was consistent across student type. However, a deeper look at patterns between online and face-to-face students reveals significant differences (see Figure 5). Specifically, online students in comparison to face-to-face students were significantly more likely to cite work, family, and other academic demands (which may be a proxy for generally having too little time available for college) as their reason for dropping out, and were also more likely to indicate higher rates of personal time commitments and a general lack of time as their reason for leaving.

Table 3. Reasons for course withdrawal by course modality—detailed sub-codes related to time.

	Fully Online	Face-To-Face	Z-Score	*p*
work	29.2%	18.6%	2.47	0.019
other academic demands	21.4%	13.3%	2.13	0.041
family	23.4%	15.9%	1.86	0.070
personal time commitments	34.1%	25.9%	1.71	0.093
commute	0.0%	1.3%	−1.18	0.120
time quality	2.9%	5.0%	−0.92	0.179
general lack of time	12.7%	9.6%	0.98	0.246

Percentages indicate proportion of students who gave responses that were coded at least once with a given code.

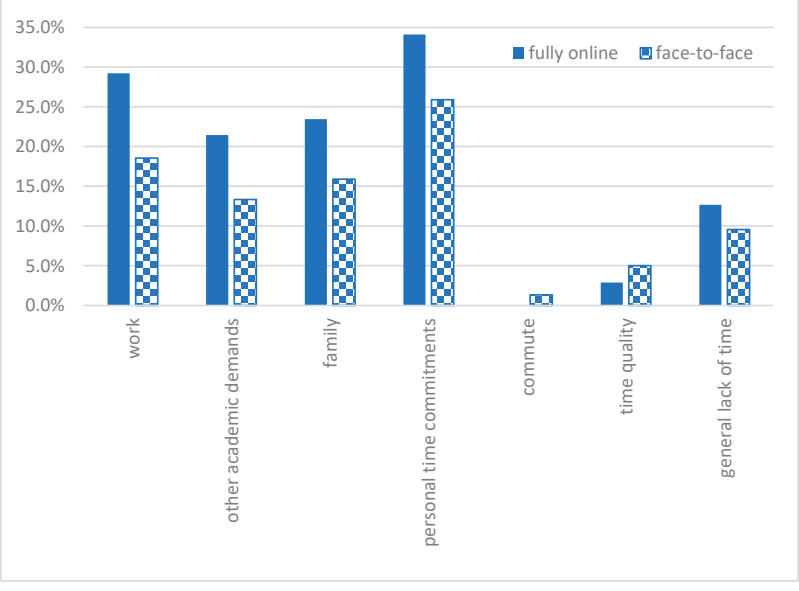

Figure 5. Graph of face-to-face vs. online course dropout reasons related to time.

6.3.1. Personal Time Commitments

Both students in online and face-to-face courses cited personal time commitments as the most prominent reason for dropping out. This supports earlier research (e.g., [86]), where students have identified personal reasons as their motivation for course withdrawal. We note in this study, students tended to explicitly and specifically name that their personal issue was a drain on their time/increased their time poverty; time poverty in this context has been defined as insufficient time to devote to college work/maintain academic well-being [14,16,34]. Furthermore, online students were more likely to report personal time commitments as a reason for dropping their courses (although these differences were not as significant as for other time-related sub-codes). When taking a deeper look at many of the online student responses, the data showed that online students tended much more often than face-to-face students to state that their experienced personal time issues were related to their mental health/health:

- *My anxiety kicked up again really strongly and I just could not handle anything involving class or work.*
- *I was unable to finish the course due to my chronic medical issues.*
- *Sudden health complications that required medical testing.*

It is important to note that our data was collected pre-pandemic, yet online student comments indicated a pattern of time limitations specifically due to personal health issues as their reason for dropping out. Pre-pandemic, student health has been linked to the ability to succeed in college; however, very little research is available [87]. Findings from this study do support some early research (e.g., [77]) specifically connecting online dropout to health and disability issues. More recently [87], we found that health-related events that occurred prior to the onset of the pandemic had a substantially and significantly larger correlation with course outcomes than those that occurred after the onset of the pandemic; we connect this to a lack of *body capital*, which "encompasses all the resources that 'live in the body': physical, mental, and psychological" [87]. Online student comments in this study support this line of reasoning and point to the need for future research on possible connections between student health, disability, and online course withdrawal.

6.3.2. Work

Both online and face-to-face students cited needing to work/work interfering with their time to study as the second most prevalent reason for dropping their courses; again, this confirms previous course withdrawal research [86]. However, work was mentioned significantly more for online students than for face-to face students as the motivation for withdrawal (26% vs. 17%):

- *My job was also placing a lot of demands on my time, which made it difficult.*
- *Could not balance the class with my hectic work schedule.*
- *The workload was more than expected, and I was unable to keep up as I had full time work.*
- *Because of my work schedule, I was unable to dedicate the time needed to do the necessary readings and turn in my assignment in a timely fashion.*

Work as a reason for course withdrawal may be connected to online enrollment in the first place; research suggests that online students are more likely to be non-traditional students who work and have family responsibilities. [3,5–7,9,14,16,58,59]. Findings from this study are consistent with other research (see review in [44,72]) that ties online course withdrawal to the time demands placed on students by their employment.

6.3.3. Other Academic Demands, Family Issues, and General Lack of Time

Students in online courses were also significantly more likely than those in face-to-face courses to indicate other academic demands (19% vs. 12%) as their reason for withdrawing from courses. However, we note that a deeper look at many of the online student responses suggests a general lack of time for all of their courses, often due to intersections of other family and work responsibilities. This corresponded to online students being more likely

(although not significantly so) to indicate family issues (21.1% vs. 14.3%) and a general lack of time (11.4% vs. 8.6%) in connection to other academic demands as their motivation for course withdrawal:

- *I no longer had time to sit and complete all the assignments.*
- *Unable to balance work, school, and personal issues.*
- *I was unable to handle the course load of that one particular class because of all the other courses I was taking in fall.*
- *I believe I took too many classes and focused more on the face-to-face class than I did with the online class.*

Overall, the data from this study related to time issues suggests any flexibility that the online medium offers may often not be enough to mitigate a student's time constraints. Our findings substantiate findings in earlier studies, noting that holding multiple life responsibilities and time management/time poverty are an issue for online students (see reviews in [11,44,72]). Furthermore, it corroborates our more resent research, which suggests that both time quality and total discretionary time has a significant direct effect on college persistence, and that time poverty may be a mediating variable in explaining course and college outcomes for students who enroll in at least one class online [14,16,34,64].

7. Implications

Our findings strongly indicate that more professional development in online pedagogy will likely be needed, both perhaps for those who taught online pre-pandemic, and especially those new to the modality who plan to continue online, to help ameliorate online course dropout. The ERT that took place during the pandemic has been found in many cases to not be based on the best pedagogical practices in online learning [88,89]. So, even though instructors may have gained experience teaching online due to the pandemic, many high quality course designs and instructional practices have not been put into practice during COVID-19. Research shows that effective online pedagogy can be significantly different from teaching face-to-face, and furthermore, that there is no single approach to training faculty who decide to teach online [90,91]. However, several established models for high quality instruction design in the online environment (e.g., Quality Matters "www.qualitymatters.org accessed on 1 September 2023"); Community of Inquiry [92] exist for use by institutions. We also note that Travers [93] reported a need for data collection on student performance and retention from programs where online instructors receive pedagogical and instructional design training versus those with only technology training. This study's findings highlight the critical role that course characteristics play in online students' decisions to withdraw, and support the need for this type of research moving forward.

At the same time, face-to-face students cited instructional quality as the most common reason for dropping, and at significantly higher rates than online students. The specific descriptions from students revealed that this was often related to the quality of in-person lectures, or the responsiveness of instructions. Thus, this study also points to a critical need for increased professional development for face-to-face instructions.

That time issues were shown to be a more critical factor for online students is notable. This is in line with recent research that suggests time poverty may play a critical role in influencing course/college completion [14,16,34]. In this study, personal time commitments were cited at higher rates for online students in comparison to face-to-face students; the nature of these commitments supports other research [77,87], tending to concentrate on personal health/mental health issues. This suggests that future research should investigate the extent to which issues of health and disability may be a major understudied factor impacting online student course withdrawal, and that institutions may wish to carefully consider additional services to meet the health/mental health needs of students even outside of COVID-19.

Furthermore, online students also significantly cited work and other academic demands—connected to family issues and a general lack of time for studies—as the motivation for their withdrawal at higher rates than face-to-face students. The findings in

this study of time issues as a critical factor motivating online student course withdrawal strongly indicates the need for greater financial aid support (e.g., to reduce employment load) and other social support services (e.g., childcare) for online students, to free up their time so they can complete their online courses. Some attempts have been made to develop combined measures of time poverty and income poverty (e.g., [94]); results from this study indicate that institutions that hope to reduce online course withdrawal in the future may do well to devote resources to development and research on interventions addressing the combined effects of lack of income and time on online course persistence.

8. Conclusions

Course withdrawal has substantial negative impacts on students in terms of lost effort and money, and research strongly indicates that it may impact not only their academic momentum but also may lead to overall college attrition [13,95]. As institutions re-calibrate to new norms post-pandemic, online courses will likely play a greater role in the higher education landscape than pre-COVID-19 [18]; a broader array of students have experienced online learning, which has heightened student interest in this modality [96]. Because dropout rates have historically been higher in online than face-to-face courses (see reviews in [4,10]), an understanding of what may specifically motivate students to drop is important for institutions to consider as they implement policies and practices post-pandemic.

Reasons for dropout found in this study point to some malleable factors motivating online course withdrawal and specific interventions post-secondary institutions could adopt. This study strongly indicates that course instructors play a core role in course withdrawal; quality of the instructor/instruction was the most cited motivation for students dropping their courses across both modalities. Students across mediums indicated lack of responsiveness and course organization as specific forms of lack of instructor/instruction quality; this is consistent with previous research (e.g., [70]). However, a deeper look at the data from this study indicates some distinct patterns of motivation for dropping courses for online students in comparison to face-to-face students. In addition to students in both mediums generally citing poor organization and lack of responsiveness, our data indicated that online students in comparison to face-to-face students cited the quality of instructional materials, a lack of understanding of instructor expectations, and the quality of peer interactions as their reasons for dropping out at significantly higher rates than face-to-face students. All of these relate to aspects of online course design, and support previous research (See reviews in [11,36,37,42,84]) highlighting the importance of these factors both in online student satisfaction and retention.

Furthermore, the findings that online students were significantly more likely to cite a lack of time as a reason for dropping out than face-to-face students point to two important implications. First, research must account for the fact that the reasons why students choose to enroll online in the first place may also contribute to student dropout. Thus, analyzing outcomes in online vs. face-to-face courses without accounting for the differing characteristics of those who choose to enroll online is problematic [4,14,16,34]. Even when comparing outcomes for online vs. face-to-face courses for the same student, students may drop online instead of face-to-face courses in which they are enrolled simply because of an overall lack of time; for example, as one student explained, "I believe I took too many classes and focused more on the face-to-face class than I did with the online". This points to broader issues with time poverty, rather than problems with the online medium itself. And second, while both online and face-to-face students cited lack of time as a frequent reason for dropping out, and therefore would likely benefit from interventions that enable them to spend more time on their studies, online students were particularly likely to cite time as a reason. Thus, one of the most important interventions for online students may not be technical support, or other interventions targeted to help students navigate online courses directly, but rather supports that free up more time for online students to spend on their studies. This could be an important shift in how supports for online students are conceptualized moving forward.

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Article

Digital Collaboration in Higher Education: A Study of Digital Skills and Collaborative Attitudes in Students from Diverse Universities

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Abstract: The current study examines the relationship between digital competencies and collaboration attitudes among higher education students. To do so, data from 1316 students from 10 Spanish universities were analyzed and collected through a questionnaire named "Basic Digital Skills 2.0 of University Students" (COBADI®—Registered Trademark: 2970648). To provide context for the sample involved in this study, it is noteworthy that 50.5% of participants typically prefer to access the internet from home. Furthermore, it was observed that most of the respondents engage with the internet for over nine hours daily. The analysis of the results was conducted by calculating correlations between digital competencies and students' collaboration attitudes. These correlations were computed using the Python programming language, with the libraries employed being pandas, numpy, and matplotlib. Students who perceive themselves as more competent in using digital tools tend to have a slightly higher disposition to collaborate with their professors in virtual environments. Some competencies are more closely associated with collaboration than others, with those that exhibit a stronger connection being key focus areas in teaching and curriculum development.

Keywords: collaboration; digital skills; higher education; students; professors

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1. Introduction

In recent years, the importance of information and communications technologies (ICT)-related skills in the process of modern and effective teaching has been highlighted in the scientific literature [1–3].

Likewise, digital integration in research activities will enable the continuous updating and expansion of knowledge through faster and more accessible access to digital information than in previous years [4]. The advent of the SARS-CoV-2 (COVID-19) pandemic has prompted higher education institutions to invest efforts in incorporating digital technologies into their curricular programs and classrooms, which traditionally operated face-to-face [5].

In the scientific literature, various terms identify digital competence; however, in line with [6], it can be considered a form of multiple and complex literacy that integrates values, beliefs, knowledge, skills, and attitudes in the technological, informational, and communicative domains. In 2018, the European Commission determined that it can also be understood as one of the basic competencies for lifelong learning, involving the safe, critical, and responsible use of digital technologies in academic, professional, and social contexts (European Commission 2018).

In recent years, research on digital competence has gained significant importance in the field of Educational Technology, both for educators and students in higher education [7]. The European DIGCOMP framework of the European Economic Community [8] encompasses areas such as information, communication, content creation, security, and problem-solving. This framework has recently been updated in its DIGCOMP 2.2 version to define assessment levels [9]. Consequently, it can be inferred that modern societies and educational institutions demand a shift in competency focus so that tomorrow's citizens acquire the skills and abilities to navigate a complex, technological, competitive, and ever-changing job market.

Recent research reveals varied digital competencies among university students, with strengths and areas needing improvement. The author of [10] notes that these competencies differ based on gender, class, and academic achievement, showing both high and moderate dimensions. The authors of [11] find that graduate students often employ information and communication technology (ICT) traditionally, influenced by gender and age. The authors of [12] report a positive outlook on digital competencies, especially in information and data literacy, but underscore the need for more training, particularly for female and rural students. The findings of [13] complement this, revealing that university and high-school students self-assess their digital skills as below intermediate, with programming as a weak point. The authors of [14], on one hand, highlight the value academics place on students' digital competences for learning, while [15] points out the lack of a systematic process for developing these competencies in university environments, suggesting the need for a new strategic approach.

In addition, effective collaboration in educational settings, emphasized by various researchers [16–18], not only enriches the overall learning experience but also contributes to heightened individual learning outcomes and increased student satisfaction. Beyond academic achievements, collaborative learning fosters a sense of community, belonging, and influence among students [19]. Additionally, as explored by [20], it plays a pivotal role in maintaining emotional support and serves as a valuable indicator of both individual student progress and group dynamics [21]. In a parallel vein, the influence of social networks as relationship contexts and content repositories as collaboration spaces is evident in the development of creativity among users [22]. Recognizing the significance of interaction, both among students and between students and teachers, is essential to grasp the intricate nature of the collaborative learning process [20].

Collaboration has a significant positive correlation with the development of digital skills, both directly and indirectly [23]. This is particularly evident in the use of digital technologies for teacher collaboration, which can enhance both teachers' and students' digital competence [24]. The level of digital skills also influences students' attitudes towards collaborative online learning [25]. Furthermore, a collaborative approach to developing teachers' digital skills, including the selection and use of digital tools, has been found to be effective [26].

Taking into account the ideas previously discussed, the aim of this article is to analyze the correlation between the development of digital competencies in university students and their collaboration attitudes in academic scenarios.

2. Methodology

The research design is non-experimental, aiming to describe the relationships between aspects without direct manipulation [27].

The data used for the study were obtained through the application of the questionnaire instrument "Basic Digital Skills 2.0 of University Students—COBADI®", with a registered trademark: 2970648. This is a self-perception questionnaire for digital competencies, implemented virtually through the following link: https://bit.ly/2p1aKVh (accessed on 27 April 2023).

The questionnaire was distributed through a non-probabilistic convenience sampling method. The questions were related to basic digital competencies, specifically consisting of

23 items distributed across three categories. The first category pertains to "Competencies in the use of ICT for searching and processing information," referring to individual competence in using various technological tools, the module analyzed in this research. This module consists of 11 items assessed through a Likert scale of 1–4 points, where 1 indicates, "I feel completely ineffective in performing what is presented" and 4 denotes, "I feel completely effective." Additionally, it includes the option NS/NC/NA (if you are not sure about the response or if it is not applicable to the question asked). The second category, "Interpersonal Competencies in the use of ICT in university settings," with 8 items, evaluates how a student resolves doubts and problems related to ICT. The third category, "Virtual Tools and Social Communication at the University," includes questions about students' use of the university's electronic platforms.

In the applied instrument, all questions were mandatory, and no personal data were collected, ensuring complete anonymity, as stated above. The questionnaire was previously validated in [28]. The instrument was available from 2013 to 2022 and was completed by 1316 students from various Spanish universities, specifically originating from the following institutions: the Autonomous University of Barcelona, the Complutense University of Madrid, the University of Huelva, the Catholic University of Ávila, the University of Granada, the University of Oviedo, the Polytechnic University of Valencia, the Higher Polytechnic School of Granada, the University of Alicante, and Pablo de Olavide University.

The data were gathered through a questionnaire entitled "Basic Digital Skills 2.0 of University Students" COBADI® (Registered Trademark: 2970648). The aim of this questionnaire is to assess the 2.0 digital skills of university students. This survey was developed and tested by members of the EDUINNOVAGOGÍA® (HUM-971) research group, recognized by the Andalusian Plan for Research, Development, and Innovation, and the Research Results Transfer Office at Pablo de Olavide University (UPO) in Seville, Spain. It has been utilized in both European Higher Education Area countries and in Latin American countries, such as Mexico and Colombia [29,30].

The approach used in this study is quantitative, with a non-experimental cross-sectional design and a descriptive-correlational scope. The two analyzed variables are presented in Table 1.

Table 1. Definition of the variables.

Variable	Definition
Development of students' digital competencies	Refers to the levels of development of the 24 digital competencies assessed in the validated COBADI instrument. Each competency was rated on a scale of 0 to 5.
Students' collaboration attitude	Students' willingness to collaborate in addressing situations that occur in the learning environment. Collaboration can take place with teachers either virtually or in-person, as well as with fellow students.

The two variables were assessed using the COBADI questionnaire, which comprises self-perception items. It was completed by 1316 students from various universities: the Autonomous University of Barcelona, the Complutense University of Madrid, the University of Huelva, the Catholic University of Ávila, the University of Granada, the University of Oviedo, the Polytechnic University of Valencia, the Higher Polytechnic School of Granada, the University of Alicante, and Pablo de Olavide University.

The competency variables analyzed were:

- A1: I can communicate with others via email;
- A2: I use Chat to interact with others;
- A3: I use instant messaging as a communication tool with others;
- A4: I can communicate with others by participating in social networks;
- A5: I am capable of operating in professional networks;

- A6: I can participate appropriately in forums;
- A7: I consider myself competent to participate in blogs;
- A8: I know how to design, create, and modify blogs or weblogs;
- A9: I know how to use wikis;
- A10: I consider myself competent to design, create, or modify a wiki;
- A11: I use the syndication system;
- A12: I know how to use social bookmarks, tagging, "social bookmarking";
- A13: I am capable of using educational platforms;
- A14: I can navigate the Internet using different browsers;
- A15: I am capable of using different search engines;
- A16: I feel competent to work with some digital mapping program to find places;
- A17: I know how to use programs to plan my study time;
- A18: I work with documents on the network;
- A19: I am capable of organizing, analyzing, and synthesizing information through concept maps using some social software tool;
- A20: I can use programs to disseminate interactive presentations online;
- A21: I feel competent to work with social software tools that help me analyze and/or navigate through content included in blogs;
- A22: I work with images using social software tools and/or applications;
- A23: I feel capable of using podcasting and videocasts;
- A24: I use QR codes to disseminate information.

Considering the above, correlation calculations were carried out by cross-referencing the listed competencies with students' collaboration attitudes (with teachers and peers). The scale for interpreting the results is presented in Table 2. The correlation calculations were carried out using the Python programming language, and the libraries used were pandas, numpy, and matplotlib.pyplot. The codes used in the Google Colab tool are presented in Table 3.

Table 2. Values and interpretation of the correlation.

Value Range	Interpretation
0.0 r < 0.10	Null correlation
>0.10 r < 0.30	Weak correlation
>0.30 r < 0.50	Moderate correlation
>0.50 r < 0.70	Moderately strong correlation
>0.70 r < 1	Strong correlation

The following question guided this study: What is the correlation between the development of digital competencies in university students and their attitudes towards collaboration in academic scenarios? Within the framework of this question, two hypotheses were defined:

- H_1: There is a strong correlation between the development of digital competencies in university students and their attitudes towards collaboration in academic scenarios. This is due to the contributions of Saputra, 2021; Muñoz, 2021; Kwiatkowska, 2022; and Yooyativong, 2018.
    - H0_1: There is no correlation between the development of digital competencies in university students and their attitudes towards collaboration in academic scenarios.
- H_2: The correlation of attitudes towards collaboration is stronger with competencies A1, A2, A3, and A4. These competencies have been specifically selected due to their direct orientation towards facilitating actions in communication.
    - H0_2: There is no significant difference between the correlation of the attitudes towards collaboration with the 24 digital competencies.

Table 3. Code written in Python and used in Google Colab.

```
from google.colab import drive
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
drive.mount('/content/drive/')
ruta_archivoNOPROMEDIO = '/_____.csv'
dataNOPROMEDIO = pd.read_csv(ruta_archivoNOPROMEDIO, delimiter=';')
correlacionesNOPROMEDIO = dataNOPROMEDIO.corr().round(2)
plt.figure(figsize = (8, 6))
plt.imshow(correlacionesNOPROMEDIO, cmap = 'coolwarm')
filas, columnas = correlacionesNOPROMEDIO.shape
for fila in range(filas):
    for columna in range(columnas):
        valor = "{:.2f}".format(correlacionesNOPROMEDIO.iloc[fila, columna])
        plt.annotate(valor, xy = (columna, fila), ha = 'center', va = 'center')
plt.colorbar()
plt.xticks(range(len(correlacionesNOPROMEDIO)), correlacionesNOPROMEDIO.columns,
rotation = 90)
plt.yticks(range(len(correlacionesNOPROMEDIO)), correlacionesNOPROMEDIO.columns)
plt.title('Matriz de correlación')
plt.show()
```

3. Results

The results were analyzed based on the population characterization and the study related to the correlation analysis between the development of digital competencies and students' collaboration attitudes.

Regarding the population characterization, more than half of the surveyed population fell within the age range of 18–20 years (66%) (Table 4).

Table 4. Number and percentage of students, by age range.

Age	n	%
18–20	874	66%
21–25	301	23%
26–30	41	3%
31–54	54	4%
N.R.	46	4%
Total	1316	100%

3.1. Population Characterization

The surveyed students belong to the educational field of Social Sciences, especially in the Bachelor's degrees in Social Education (38.4%) and Double Bachelor's degrees in Social Education and Social Work (31.2%) (Table 5).

Table 5. Number and percentage of the degree pursued by those who responded to the questionnaire.

Degree	n	%
Double Bachelor's degree in Social Education and Social Work	411	31.2%
Social Education	506	38.4%
Social Work and Social Education	30	2.3%
Bachelor's degree in Social Work	263	20.0%
Other degrees	106	8.1%
Total	1316	100%

Regarding the usual location for internet connection, more than half (50.5%) of the respondents prefer to connect at home, or, alternatively, anywhere using a mobile device (46.4%) (Table 6). In this regard, the study aligns with a study conducted on teacher education students in Uruguay [31], where, for several activities, mobile usage was preferred to the laptop distributed for free under the educational policy. Additionally, other research studies [28,32–34] demonstrate students' interest and motivation in using mobile devices in educational settings and their implications for students' learning outcomes.

Table 6. Most common location to connect to the internet.

Internet Connection	n	%
At home	665	50.5%
At friends' homes	5	0.4%
At the university	23	1.8%
At a cybercafé	-	-
Anywhere because I have a mobile device	611	46.4%
Other	12	0.9%
Total	1316	100.0%

Ultimately, it is noted that more than half of the respondents frequently use the internet (over 9 h per day) (Table 7). In this regard, the study aligns with the research by [35], which indicated that 50% of the university population connected to the internet every day, mainly for chatting (76.4%), downloading movies and music (52%), and studying (32.6%). Similarly, a survey conducted in 2018 by the Association for Media Research [36] on Spanish internet users identified that users over the age of fourteen primarily use mobile phones to access the internet, with over 40% spending more than 4 h online daily.

Table 7. Dedication to browsing the internet during the week, by range of hours per week.

Time	n	%
Between 1 and 3 h	176	13.4%
Between 4 and 9 h	438	33.3%
More than 9 h	675	51.3%
Other	27	2.0%
Total	1316	100.0%

3.2. Correlation Analysis

In this section, the correlation between two variables is presented: (1) development of digital competencies and (2) collaboration attitude of the students. The outcomes are divided and presented in accordance with the two hypotheses formulated earlier.

3.2.1. H1: There Is a Strong Correlation between the Development of Digital Competencies in University Students and Their Attitudes towards Collaboration in Academic Scenarios

Figure 1 shows the correlation of the total skills versus collaboration in a heatmap. Table 8 presents the complete correlation matrix for each of the 24 skills and collaboration. The following figures display heatmaps of the correlations for the seven skills that exhibited the highest values.

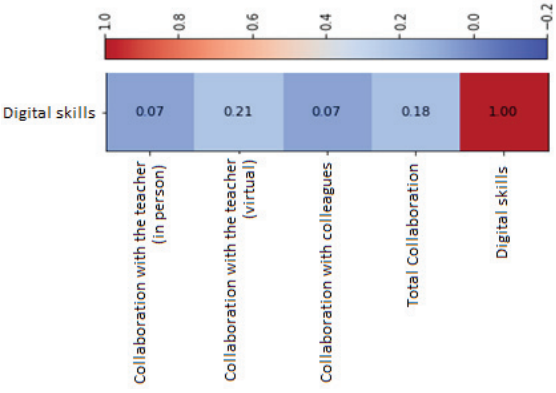

Figure 1. Correlation between the development of digital competencies and student collaboration attitude.

Table 8. Correlation matrix.

Competency Variables	Collaboration with Teacher (Face-To-Face)	Collaboration with Teacher (Online)	Collaboration with Peers	Total
A1	0.04	0.08	0.02	0.07
A2	0.03	0.04	0.08	0.08
A3	0.04	0.05	0.02	0.05
A4	0.04	0.05	0.06	0.08
A5	0.07	0.06	0.10	0.12
A6	0.05	0.13	0.06	0.12
A7	0.02	0.12	0.05	0.10
A8	0.03	0.08	0.01	0.06
A9	−0.01	0.07	0.04	0.05
A10	0.04	0.11	0.06	0.11
A11	−0.01	0.04	0.06	0.05
A12	0.03	0.04	0.03	0.05
A13	0.03	0.10	0.03	0.05
A14	0.03	0.07	0.03	0.07
A15	0.02	0.11	0.06	0.11
A16	−0.03	0.12	0.06	0.08
A17	0.00	0.13	0.10	0.13
A18	−0.01	0.12	0.13	0.13
A19	0.03	0.12	0.08	0.13
A20	−0.01	0.14	0.13	0.15
A21	0.02	0.07	0.07	0.09
A22	0.02	0.08	0.04	0.08
A23	0.05	0.13	0.05	0.12
A24	0.04	0.10	0.11	0.14

In Figure 1, it is evident that there is a weak correlation between the development of digital competencies and virtual collaboration with the teacher. Conversely, there is no correlation between the development of digital competencies and collaboration with peers or in-person collaboration with the teacher.

In Table 8, on the other hand, it is observed that the correlations are either null or weak. In the specific case of the correlation between digital competencies and in-person collaboration with the teacher, all results indicate that there is no such correlation. Meanwhile, virtual collaboration with the teacher more frequently shows a weak correlation with digital competencies.

3.2.2. H2: The Correlation of Attitudes towards Collaboration Is Stronger with Competencies A1, A2, A3, and A4

The highest correlations obtained in this study are presented between collaboration and the following competencies:

- A6: I am able to participate appropriately in forums (Figure 2);
- A17: I know how to use programs to plan my study time (Figure 3);
- A18: I work with documents on the network (Figure 4);
- A19: I am able to organize, analyze, and synthesize information using concept maps with some social software tool (Figure 5);
- A20: I can use programs to disseminate interactive presentations online (Figure 6);
- A23: I feel capable of using podcasting and videocasts (Figure 7);
- A24: I use QR codes to disseminate information (Figure 8);
- The competency that has the strongest correlation with collaboration is A20—I can use programs to disseminate interactive presentations online (Prezi, SlideShare, Scribd, etc.), followed by A24: I use QR codes to disseminate information.

The forums mentioned in Figure 2 refer to those offered on academic platforms but also on sites like mass media or blogs. The planning tools mentioned in Figure 3 include, for example, Google Calendar or Outlook Calendar. Examples of documents on the network in Figure 4 are Google Drive and SkyDrive. The mind maps in Figure 5 are created using tools like Cmaptool, Mindomo, Text2mindmap, Bubbl. The presentation tools in Figure 6 include Prezi, SlideShare, Scribd, and Canvas, among others. The podcasting and videocasts mentioned in Figure 7 can be created using tools like Flicks, Odeo, and YouTube. Finally, for sharing information via QR codes, various free tools like qrcode-generator are available.

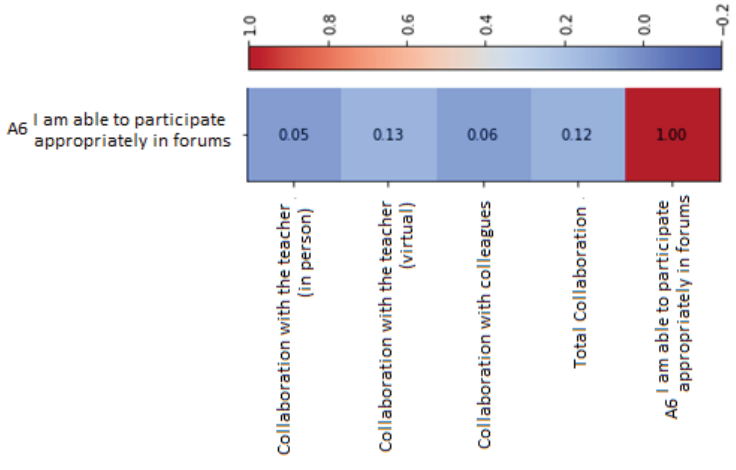

Figure 2. Correlation between skill A6 and collaboration.

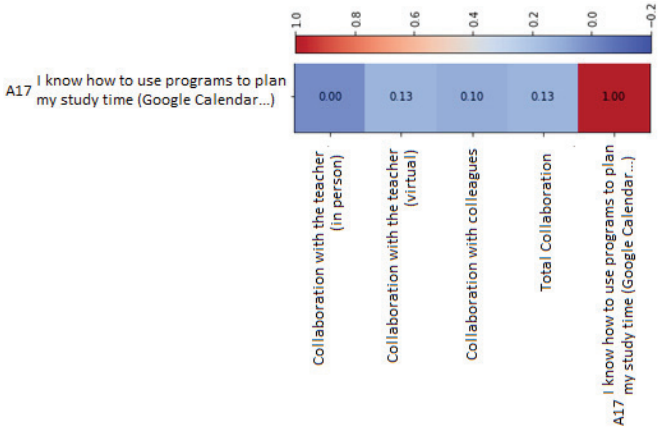

Figure 3. Correlation between skill A17 and collaboration.

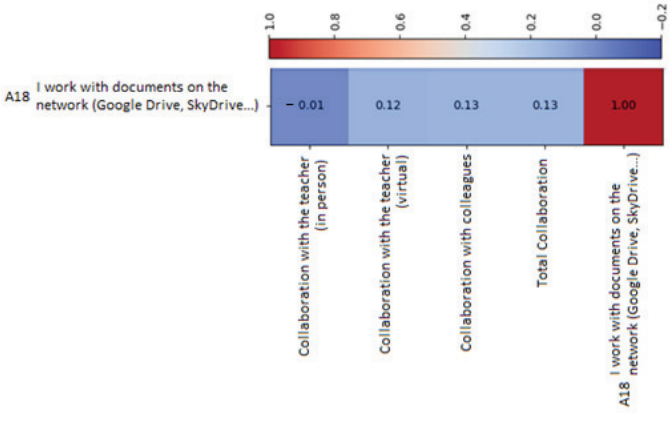

Figure 4. Correlation between skill A18 and collaboration.

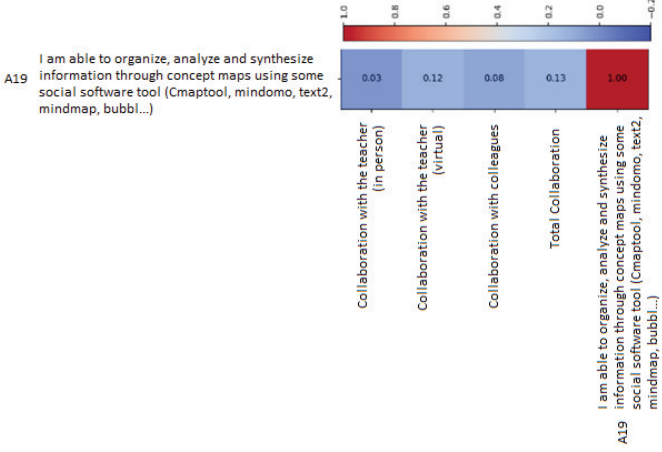

Figure 5. Correlation between skill A19 and collaboration.

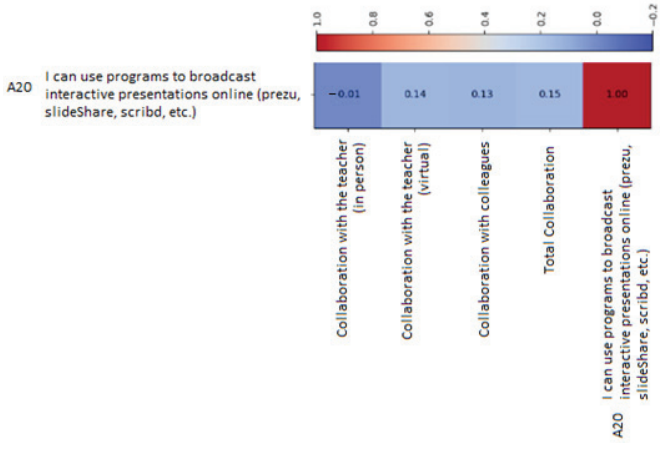

Figure 6. Correlation between skill A20 and collaboration.

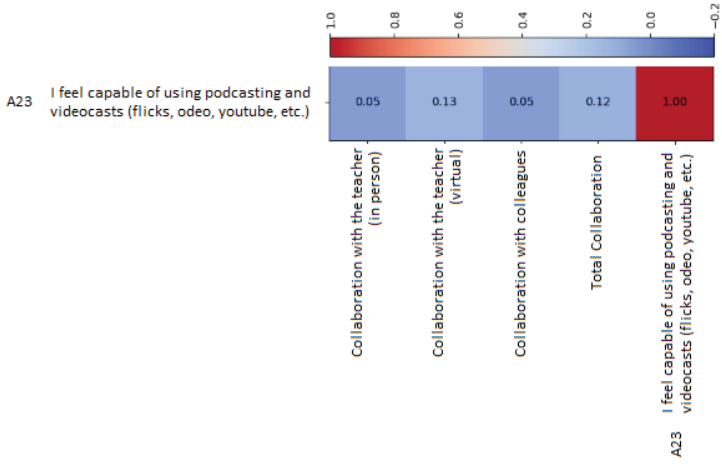

Figure 7. Correlation between skill A23 and collaboration.

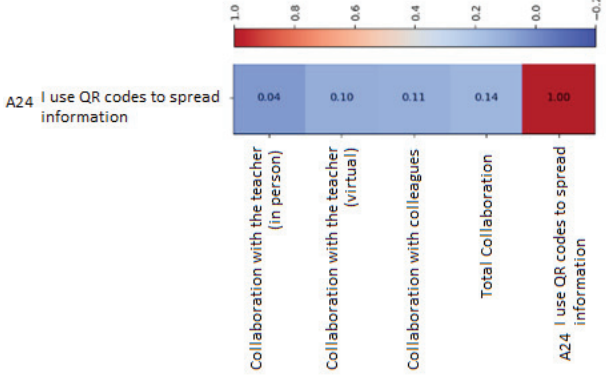

Figure 8. Correlation between skill A24 and collaboration.

4. Discussion

The analysis of the results obtained in this study on the relationship between the development of digital skills and students' collaboration attitudes in educational environments provides a deeper understanding of how these two variables are interconnected and their implications for teaching and learning. It underscores the importance of digital skills in current education, aligning with other studies indicating that, as technology becomes increasingly integral in everyday life and the workplace [37,38], it is essential for students to develop strong digital skills. It emphasizes the consideration that digital skills not only encompass the technical ability to use digital tools but also the skills to communicate, collaborate, and problem-solve in digital environments [39].

Regarding hypothesis 1, the interplay between digital skills and collaboration in educational settings presents a multifaceted picture. On one hand, this study shows that a weak correlation is observed between the development of digital skills and virtual collaboration with professors (Figure 1). On the other hand, the scientific literature shows that collaboration is positively linked to the development of digital skills, as [23] points out, and as [25] suggests: the level of digital skills has a marked impact on students' attitudes towards collaborative online learning. The weak correlation found in this study can be attributed to factors beyond digital competence, such as the structure of online courses, the quality of virtual interactions, and professors' enthusiasm for fostering collaboration.

Additionally, the correlation becomes null when considering peer collaboration or in-person interactions with professors (Figure 1). This indicates that digital skills might not be pivotal in determining students' willingness to collaborate with their peers. Instead, elements like group dynamics, personal interaction, and the nature of assigned tasks seem to hold greater significance in this context, as highlighted in studies by [40–42].

Research indicates that disparities in technological access can significantly impact the correlation between digital skills and virtual collaboration [43,44]. The digital divide, particularly in terms of income-related access to computers, can further exacerbate these disparities [43]. This is particularly problematic for digitally excluded youths, who face challenges in developing digital skills due to poor access to technology and limited support networks [44]. To address these disparities, it is crucial to provide students with opportunities to develop virtual collaboration skills, particularly in the context of a virtual work environment [45].

When examining the individual correlations between the 24 specific digital skills (Hypothesis 2) and collaboration, it is highlighted that some skills are more related to collaboration than others, but the differences are not significant. Those closely related skills become key areas of focus in teaching and curriculum development. Skills such as time planning, working with documents online, organizing and synthesizing information through concept maps, creating interactive online presentations, using podcasting and videocasting, and disseminating information through QR codes show the highest correlations with collaboration [46,47]. For instance, the ability to participate appropriately in forums, use time planning tools, and work with online documents positively correlates with collaboration. This suggests that students skilled in time management and digital content creation are more likely to actively collaborate in educational environments. A notable observation pertains to competencies A1, A2, A3, and A4, which are directly linked to the practice of communication (Table 8). Contrary to expectations, these competencies do not exhibit a stronger correlation with collaboration. The outcomes of this research present a divergence from the conclusions drawn in previous studies: [48,49] both highlight the potential of digital tools in enhancing collaborative creative work, with the latter also noting the need for new competencies to effectively utilize these tools. The authors of [50], contributing their perspective, discuss the use of eScience tools, including XML data representations and Web 2.0 social networking tools, to support collaboration and virtual organizations. This suggests that the interplay between communication-related skills and collaboration might be more complex than initially anticipated (Table 8).

However, the null correlation between the remaining specific digital skills and collaboration may be related to the design of educational environments and how collaboration is encouraged. In some cases, courses may not be fully leveraging the potential of digital tools to promote collaboration. Improving course design and effectively integrating digital tools could positively influence collaboration [51,52]. It is important to note that this null correlation does not necessarily imply that these digital skills are not valuable or relevant in the educational context, but refers to the fact that in-person collaboration with professors may depend on other factors, such as classroom dynamics, the professor's willingness to encourage in-person collaboration, activity design, and other elements that go beyond students' digital skills [53].

It is essential to recognize that the value of digital skills in the educational sphere extends beyond their direct correlation with collaborative outcomes. The absence of a strong link between specific digital skills and collaboration could stem from underutilized pedagogical strategies rather than the irrelevance of these skills.

5. Conclusions

The growing integration of technology in education has turned digital skills into an essential aspect of learning and preparation for the workforce. The results of this study underscore the importance of students acquiring strong digital skills to thrive in an increasingly digitized educational and work environment.

This study found a weak correlation between the development of digital competencies in university students and their attitudes towards collaboration in academic scenarios. Hence, the alternative hypothesis is invalidated, while the null hypothesis is affirmed. The rejection of the second alternative hypothesis is warranted due to the absence of statistically significant differences observed in the correlations between the collaboration and the digital competencies under investigation.

The complex relationship between digital skills and various forms of collaboration in educational environments necessitates a nuanced understanding of the multiple factors that influence these dynamics.

However, it is important to note that this study is based on data collected from a specific sample of university students in the field of Social Sciences. Therefore, there is potential for further research to explore these relationships in different educational contexts and student populations to gain a more comprehensive understanding of this evolving topic in contemporary education.

The results of this study should be interpreted taking into account several limitations, such as the fact that the level of digital competence was measured with a single instrument that could have been complemented by other instruments, such as interviews and focus groups, to enrich the results. The specific sample corresponds to students in the field of Social Sciences and only to Spanish universities. Future studies should include larger samples of university students from other disciplines and countries to draw more generalizable conclusions. Moreover, correlation does not imply causation, so it cannot be affirmed that the development of digital skills leads to an increase in collaboration. From a prospective perspective, it could be examined how course design and specific pedagogical strategies influence the relationship between digital skills and collaboration.

The relationship between digital skills and collaboration is complex and requires additional studies that include more diversified samples and complementary methodological approaches.

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Student Ratings: Skin in the Game and the Three-Body Problem

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Abstract: To capture the student voice, university researchers examined the high-stakes Student Perception of Instruction form, administered online to students each semester, allowing them anonymous feedback on their courses. A total of 2,171,565 observations were analyzed for all courses each semester from fall 2017 through fall 2022. The results indicated that 68% of students responded identically to each of the protocol's 9 Likert scale items, essentially straight-lining their rating of instruction and casting doubt on the validity of their engagement with the process. Student responses by various University demographics are presented. We discuss the potential influences of students' reactions and present a possible model for effective teaching and evaluation.

Keywords: student ratings; student voice; student perception of instruction; higher education

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1. Introduction

An ongoing concern in higher education is how to include the student voice in teaching. Most professional educators agree that doing so will improve educational effectiveness, better accommodate our diverse student population, and show that universities can respond to rapid societal changes. At the current time, the student voice primarily comes through two channels. The first is traditional and has been in place for almost a century [1]. In this approach, students provide feedback about their learning experience at the end of their courses using a rating scale instrument. Customarily, this process is formalized and controlled by a unit designated by the university administration. In theory, it has three functions: formative feedback for instructors, summative information for faculty evaluation, and lending credibility to the student voice.

However, it is no secret that the system has broken down for several reasons—one focus of this article. Students tell us they feel like robots rating every course but never seeing any tangible impact, so what is the point? They have no skin in the game because they perceive that their opinions do not impact change in the instructional practice. A second issue with this approach involves the usefulness of the data for any kind of valid faculty evaluation [2].

This led to the second "channel" for the student voice: an alternative, informal, uncontrolled, and virtual student evaluation of their courses and instructors. Students make their opinions available worldwide through sites such as ratemyprofessor.com, YouTube, X (formerly known as Twitter), Facebook, Instagram, TikTok, and Reddit. This "wild west" student evaluation happens in other spaces as well: fraternity and sorority houses, individual chats and text messages, businesses, and other places where students gather virtually or face to face. Faculty reputations are created in the alternative evaluation universe and spread like parasite memes, as Dawkins calls them in "The Selfish Gene" [3]. The reality is that this channel for student feedback continues to challenge the formal systems developed by universities as it is further reaching than the on-campus "form".

1.1. Skin in the Game

In the introduction, we used the term "skin in the game", indicating that students have no real investment in end-of-course ratings—and, for that matter, university faculty

and administrators may not either. The term originated in the betting industry, where if a horse you own is in a race, you have skin in the game. The notion gained traction, referring to situations where individuals have a stake in the success or failure of a project or relationship, causing them to be personally invested in their actions and decisions.

The idea found widespread application in business and many aspects of society as a way to ensure that people assume responsibility and face the consequences [4–9]. In higher education, students assume more responsibility when they are actively engaged in their learning process, knowing that their efforts directly impact their futures. They gain a deeper understanding of the subject matter and develop critical thinking and problem-solving skills that allow them to apply their learning in real-world situations, preparing them for success beyond the classroom. Students who overcome obstacles become what Taleb [10] calls antifragile, developing strength from changing circumstances and building a foundation for lifelong learning. Similarly, educators who are committed to their students' success will make every effort to provide quality education and create a nurturing and supportive network that results in prepared and motivated graduates.

"Skin in the game" creates an atmosphere of accountability and ethical behavior in organizational leadership. However, its absence can lead to disastrous outcomes, as exemplified by the 2008 financial crash. McGhee [11] explains what happened when banks bypassed any responsibility for their subprime lending practices:

> The loans are called subprime because they're designed to be sold to borrowers who have lower than-prime credit scores. That's the idea, but it wasn't the practice. An analysis conducted for the Wall Street Journal in 2007 showed that the majority of subprime loans were going to people who could have qualified for less expensive prime loans. So, if the loans weren't defined by the borrowers' credit scores, what did subprime loans all have in common? They had higher interest rates and fees, meaning they were more profitable for the lender, and because we're talking about five- and six-figure mortgage debt, those higher rates meant massively higher debt burdens for the borrower". (p. 69)

> Never mind that most of the predatory loans we were talking about weren't intended to help people purchase homes, but rather, were draining equity from existing homeowners. (p. 89)

> Wall Street brokers even came up with a lighthearted acronym to describe this kind of hot-potato investment scheme: IBGYBG, for 'I'll be gone, you'll be gone.' If someone gets burned, it won't be us. (p. 92)

This is an example of what can happen when institutions feel free to exploit the underclasses, believing they are impervious to the consequences of their behavior. The irony of the situation was that as long as housing prices continued to rise, the scheme worked; but, as soon as they began to fall, the system collapsed.

Student course ratings appear to have minimal skin in the game for the constituencies involved. From a student's perspective, the time and effort taken to complete course evaluations has no effect on the course or the professor. In most cases, instructors only see their ratings after the course is completed. There is an absence of psychological contracts between faculty and students about how an evaluation system will function. The financial rewards for faculty are at most minimal, so their ratings have virtually no impact on salary increases. All parties concerned are suspect of the metrics provided by these data, and university administrators are skittish about high-stake decisions based on the evaluations. University bodies like the faculty senate are quick to criticize the system but have little to offer in the way of alternatives. In most instances, more comprehensive approaches are so labor-intensive that the opportunity costs are prohibitive. Often, in universities, the responsibility for redesigning the faculty evaluation procedures falls to dotted line units such as the faculty center that only have the authority to make recommendations. At the moment, faculty ratings by students resemble Catch-22 [12]. Nobody wants to be evaluated in the current system because the results are suspect, but if you do not evaluate courses,

you are not committed to teaching effectiveness, so you keep using a system you do not trust. Yossarian would be proud.

1.2. The Three-Body Problem

Another issue in this study hinges on student ratings in the context of the three-body problem: predicting the motion of three bodies under common gravitational forces. Although appearing unrelated to student ratings, the issue clarifies understanding students' evaluation because parallels between the two typify the complex dynamics of instructional effectiveness in higher education [13–17]. The challenge for both physics and education lies in their mutual complexity and the difficulty of obtaining exact solutions because of uncertainty and unpredictability [18,19]. Three fundamental issues underlie the problem.

1. Interaction complexity: The culture of higher education involves complex interactions among students, instructors, curriculum, and course content.
2. Inherent unpredictability: In both contexts (physics and education), the result is a long-term chaotic pattern. The interaction of student ratings with such things as teaching style, student engagement, overall experience, and individual student dispositions typifies a complex system. Addressing this unpredictability is key to understanding the student voice.
3. Positive feedback loops: Student ratings experienced a sustained positive feedback loop reinforcing the system. We have been doing this for years, so change is hard, and really, the ratings do tell us something. Faulkner [20] is reputed to have said "a fellow is more afraid of the trouble he might have than he ever is of the trouble he's already got". Early typewriters, for example, tended to jam their keys—especially fast typists. To solve the problem, the letters QWERTY were placed on the upper left corner of the keyboard to separate the most used letters. This slowed the typists and reduced the jamming. Of course, typists became familiar with the arrangement and grew more proficient, thereby increasing efficiency. As new companies manufactured typewriters, there was no point in another keyboard arrangement because QWERTY was in place and universally used. Typists were trained in that system, creating an autocatalytic positive feedback loop that dictated the production of keyboards that has endured for 150 years. Student ratings underwent a similar positive reinforcement cycle, causing them to endure for almost 100 years.

The Three-Body Problem analogy to student ratings presents an open-ended challenge: no general solution exists because initial starting points are best guesses. This task before us is to devise entrepreneurial approaches that lead to satisfactory solutions [21–23]. This requires innovation, creativity, critical thinking, and trial and error. Embracing this uncertainty, ambiguity, and ambivalence can result in a sustainable and effective system for the assessment of teaching and learning from the student's perspective.

2. What the Literature Says: An Alternative Approach

2.1. A Seismic Shift in the Literature Review Paradigm

Examining Table 1, the number of articles about student evaluation of teaching identified by seven different platforms confirms a daunting problem for reviewing the literature on any topic. The internet, the cloud, electronic journals, blogs, videos, and a host of social media platforms have created literature bases that defy systematic analysis. Because of their constant churn and the discrepancies in numbers, traditional literature reviews have become increasingly difficult. A raft of other problems exists as well: overwhelming size, vague and overlapping classifications, mislabeling, excessive redundancy, inaccurate identification, and search tediousness.

Table 1. An emergent property representation of student rating literature.

Author(s)	Summary
Google Scholar	507,000
Academic Search Premier	21,623
Pro Quest	173,249
JSTOR	63,288
ERIC	61,776
World Wide Science	687,670
Web of Science	34,836

However, in recent months, artificial intelligence (AI), or more accurately, large language models, have lifted the concept of AI out of its doldrums, where it languished for years. Procedures such as neural networks, classification and regression trees, and nearest neighbor methods have enabled platforms such as ChatGPT to process huge amounts of information bits almost instantly, giving the impression of semantic thought. Floridi [24], however, offers a caution about that misconception in his article "AI As Agency Without Intelligence: On ChatGPT, Large Language Models, and Other Generative Models". He frames it this way:

> They do not think, reason, or understand; they are not a step towards any sci-fi AI; and they have nothing to do with the cognitive processes present in the animal world and, above all, in the human brain and mind, to manage semantic contents successfully [25]. However, with the staggering growth of available data, quantity and speed of calculation, and ever-better algorithms, they can do statistically—that is, working on the formal structure, and not on the meaning of the text they process—what we do semantically, even if in ways (ours) that neuroscience has only begun to explore. Their abilities are extraordinary, as even the most skeptical must admit. (pp. 1–2)

> The exercise is no longer to make summaries without using ChatGPT, but to teach how to use the right prompts (the question or request that generates the text. (p. 2)

These generative models are finding application in situations ranging from, but by no means bounded by, medical diagnosis to literary critique and analysis. Therefore, it is not surprising that these platforms have found their way into reviews of literature. For instance, Kabudi et al. [26] demonstrated an approach to using generative AI where specified apriori categories had the platform select initial literature sets and then apply multiple criteria to identify the most relevant subsets. The platform then "examined" those resources and placed clusters of articles into reasonably homogenous groups by aligning them with a strategic labeling process. This allowed the investigators to evaluate and organize their review. That platform accomplished what no group could do in a professional lifetime. Several authors cited the potential of these generative large-language AI platforms:

- Makes searching for relevant articles much faster [23,27–32]
- Has the ability to write entire summaries within seconds [30,33–35]
- Extremely effective for the editing process: checking grammar, creating citations, making an outline, etc. [27,36,37]
- Can help synthesize the chosen articles [29,31,34]

2.2. A Blended Approach

Table 2 represents the results of an incomplete traditional review summary of the literature conducted by the authors, but instead of a narrative, the results are presented in tabular form and classified (by the authors) under unifying subcategories. This typifies a folksonomy where the topic headings emerge in a self-organizing pattern characteristic of complex systems. Next, the authors independently identified subcategories under each organizing heading, then, as a group, negotiated the consensus. Based on that negotiation,

they designed a graphic visualization of the literature that provides a structural framework and connections to individual research papers. This addresses the micro−macro problem where reviewing individual articles does not necessarily produce a model that identifies important patterns. However, this semantic approach is labor-intensive and rests on the assumption that the sample of articles selected is representative of the body of literature. Figures 1–4 present the visual result of this analysis (micro to macro) with the author-identified categories.

Table 2. Student rating literature citations from several platforms.

Resource	"Student Evaluation of Teaching"
Course Modality, Level, and Content	
Royal, K.D., & Stockdale, M.R. [38]	Students are more critical of professors teaching quantitative courses
Dziuban, C., & Moskal, P. [39]	Students do not consider course modality when completing evaluations
Glazier, R.A., & Harris, H.S. [40]	Students rate professors positively based on their teaching type regardless of course modality
Samuel, M. L. [41]	Students rated instructors in flipped classroom settings significantly higher
Liao, S., Griswold, W., Porter, L. [42]	Peer instruction with small groups consistently received higher ratings than larger, lecture-based classes
Capa-Aydin, Y. [43]	Students rated the in-class course much higher than the online course
Uttl, B., Smibert, D. [44]	Students rated quantitative courses significantly lower than non-quantitative courses
Brocato, B.R., Bonanno, A., & Ulbig, S. [45]	Instructors teaching online courses received lower ratings from students; Female instructors were rated higher
Filak, V.F., & Nicolini, K.M. [46]	Students were less satisfied with their online courses than face-to-face courses
Sellnow-Richmond, D., Strawser, M. G., & Sellnow, D.D. [47]	Online and hybrid students value flexibility but wish for more interaction and lecture-based teaching
Lowenthal, P., Bauer, C., Chen, K. [48]	Students rate online courses lower than face-to-face courses; graduate students are more critical of online course instructors; students rated tenured and tenure-track faculty lower than adjuncts
Yen, S.-C., Lo, Y., Lee, A., & Enriquez, J.M. [49]	Students in online, face-to-face, and blended formats were equally satisfied with their learning outcomes
He, W., Holton, A., Farkas, G., & Warschauer, M. [50]	Ratings on flipped instruction vs. traditional lectures were not significantly different
Mather, M., & Sarkans, A. [51]	Online students enjoy flexibility and convenience but want more timely feedback and interaction
Turner, K.M., Hatton, D., & Theresa, M. [52]	Online classes are rated lower than in-person; undergraduate students are more critical; larger classes receive lower ratings; classes with heavy workloads receive lower ratings
Peterson, D.J. [53]	Students in flipped classes rated course/professor higher than students in traditional lecture-based courses
Student Factors (Decision, Perception)	
Dziuban, C., Moskal, P., Kramer, L. & Thompson, J. [54]	As student ambivalence increases, so does the number of elements they use to evaluate their courses
Kornell, N., & Hausman, H. [55]	Students are unaware of what constitutes "good teaching" and just evaluate based on their class
Ernst, D. [56]	Students consider many factors when making the decision to fill out evaluations
Dziuban, C., Moskal, P., Thompson, J., Kramer, L., DeCantis, G., & Hermsdorfer, A. [57]	Understanding psychological contracts plays an important role in student satisfaction

Table 2. *Cont.*

Resource	"Student Evaluation of Teaching"
Griffin, B. [58]	Autonomy in courses leads to higher satisfaction and ratings
Richmond, A., Berglund, M., Epelbaum, V., Klein, E. [59]	Higher student ratings are based on the rapport between student and teacher, level of engagement, and personality of the professor
Scherer, R., Gustafsson, J.E. [60]	Students who achieved more in the course gave higher ratings
Gündüz, N. and Fokoué, F. [61]	A strong association exists between a student's seriousness/dedication and the ratings they assign to the course/professor; Identified zero variance responses
Bassett, J., Cleveland, A., Acorn, D., Nix, M., & Snyder, T. [62]	The majority of students only occasionally put significant effort into their rating responses
Instructor Factors (Role, Perception, and Impact)	
Mandouit, L. [63]	Student feedback is an important tool and powerful stimulus for instructor reflection
Wang, M.C., Dziuban, C.D., Cook, I.J., & Moskal, P.D. [64]	Instructor interest in their students' learning resulted in excellent ratings; low respect exhibited by instructors resulted in poor ratings overall
Golding, C., & Adam, L. [65]	Provides strategies for teachers to take student ratings into account when improving their teaching for future courses
Floden, J. [66]	Student feedback is perceived positively by university teachers, has a large impact on their teaching, and helps improve courses
Badur, B. and Mardikyan, S. [67]	Teachers with well-prepared courses, positive attitudes, and part-time professors consistently received higher ratings
Kim, L.E., & MacCann, C. [68]	Instructor personality impacts a student's evaluation of their teaching
Foster, M. [69])	Professors addressed by their first name receive higher ratings than those who go by their title/last name
Bias and Validity Concerns (gender and background in university decisions, based on a student's personal success)	
Mengel, F., Sauermann, J., & Zolitz, U. [70]	Female professors receive lower ratings compared to their male counterparts
Stark, P.B., & Freishtat, R. [71]	Ratings may be reliable but are not necessarily valid/accurate; universities should abandon using student evaluations as the primary factor for promotion and tenure decisions
Heffernan, T. [72]	Abusive and rude comments common toward female professors and professors from minority backgrounds
Tejeiro, R., Whitelock-Wainwright, A., Perez, A., Urbina-Garcia, M.A. [73]	Students who received higher grades and are academically successful provide higher course evaluations
Stott, P. [74]	Students with poor grades are likely to rate their online instructors poorly
Esarey, J. & Valdes, N. [75]	Imprecision in the relationship between student evaluations and instructor quality
Kogan, V., Genetin, B., Chen, J., and Kalish, A. [76]	Students with better grades are more satisfied and leave higher ratings; not ideal to use evals for important decisions
Boring, A., Ottoboni, K., & Stark, P.B. [77]	Student evaluations are biased against female instructors
Flaherty, C. [78]	Evaluations tend to be biased against women; need to explore gender bias and tenure decisions
Flaherty, C. [79]	Major university decisions are in the hands of students who may be biased against their professors who are female or from racial minorities
Flaherty, C. [80]	Validity concerns due to grade satisfaction play a major role in how students evaluate
Flaherty, C. [81]	Student evaluations contain measurement bias and equity bias
Genetin, B., Chen, J., Kogan, V., & Kalish, A. [82]	Gender and racially implicit bias language on student evaluations need to be changed so students can still share concerns but not at the expense of their instructors

Table 2. *Cont.*

Resource	"Student Evaluation of Teaching"
Stroebe, W. [83]	Grade inflation may be due to student evaluations being used for determining major university decisions
Ray, B., Babb, J., & Wooten, C.A. [84]	Women instructors are held to a higher standard and have to work harder to be seen as competent
Goos, M., & Salomons, A. [85]	A low student response rate creates positive selection bias, meaning true evaluation scores may be lower
Boring, A., Ottoboni, K., & Stark, P. [86]	Female instructors receive lower scores than male instructors; students who expect to receive a higher grade are more likely to give higher ratings
Mitchell, K.M., & Martin, J. [87]	Considerable discrimination against female instructors in student ratings
Hornstein, H.A. [88]	Validity concerns regarding student evaluations are common
Buser, W., Batz-Barbarich, C., & Hayter, J. [89]	Female instructors rated significantly lower than male instructors; a student's expected grade strongly predicts their ratings
Chatman, J., Sharps, D., Mishra, S., Kray, L., & North, M. [90]	Even if a female instructor has similar performance as their male counterparts, they are still rated significantly lower

Subsequently, however, Table 2 was submitted to ChatGPT where the authors asked the platform to identify four categories under each major heading. That result is also contained in Figures 1–4, showing a close (not exact) correspondence to the authors' work. This macro result helps validate the organizing structure of the research literature in student ratings of their courses from a combination of human cognition and machine learning—perhaps a shift in the way forward for capturing research findings that resonate with the digital age.

This review of student ratings in higher education is organized by four fundamental factors: course modality, student and instructor context, and validity. Each one plays a significant role in shaping student perceptions and experiences. Considering them from a macroperspective offers a comprehensive understanding of the issues. Course modality sets the stage for understanding the student's learning experience. Student and instructor contexts represent two personal components of course evaluation. However, conducting a review of the literature must embrace validity elements that influence student responses.

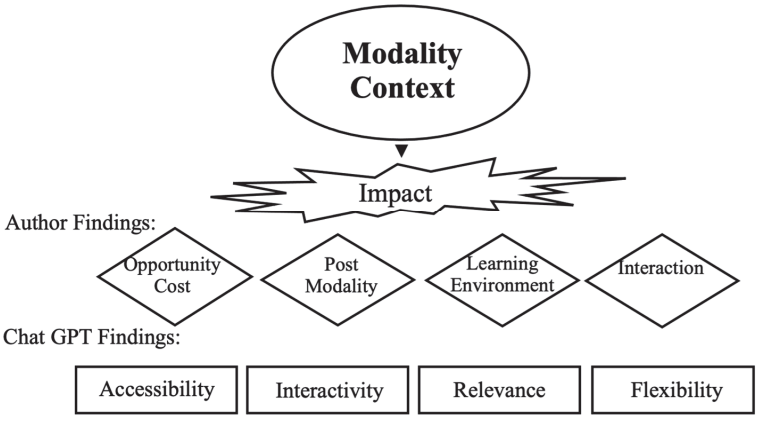

Figure 1. The learning arrangement construct.

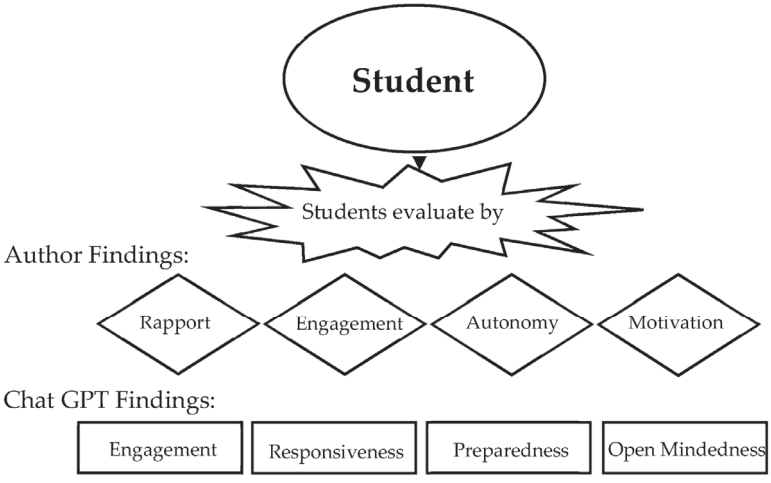

Figure 2. The student involvement construct.

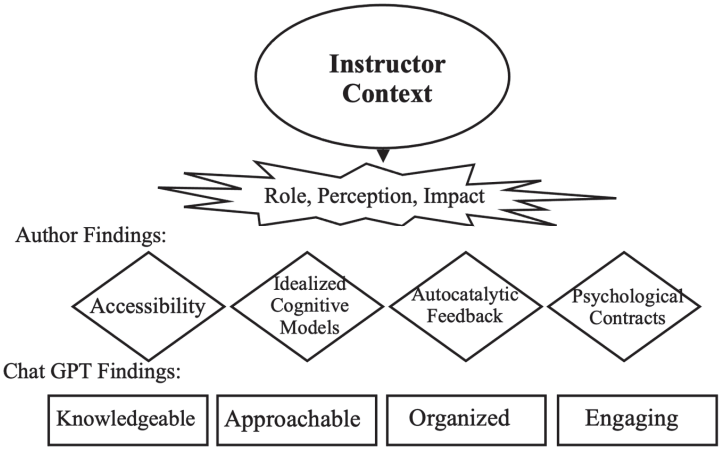

Figure 3. The teaching environment construct.

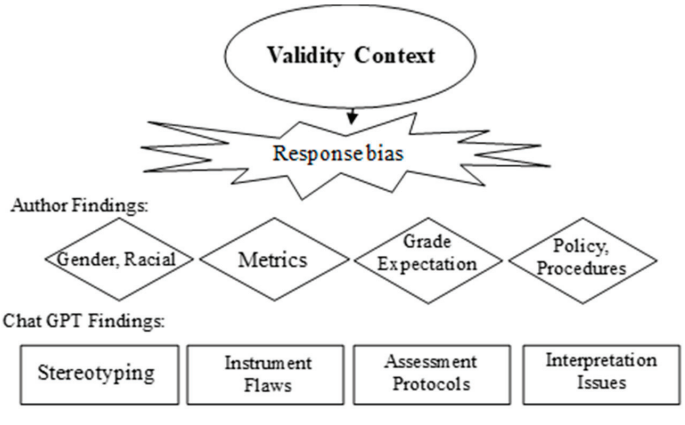

Figure 4. The measure quality construct.

Incorporating technology and utilizing approaches such as human semantic analysis and AI-based analysis like GPT enhances the process of analyzing the overwhelming number of articles. In this world of evolving technological innovations, conducting a valid review of the literature requires a multifaceted approach that considers the interplay of many factors enhanced by augmenting categories. By analyzing these factors in their interactive complexity, educators, administrators, and researchers can gain a more universal understanding of the variables affecting course evaluations.

3. What the Data Show

3.1. The Data Collection Procedures

The end-of-course Student Perception of Instruction at the University of Central Florida was the data source for this study (Appendix A). The rating scale has been redesigned and modified several times, with the current version resulting from a series of faculty, student, and administration groups working collaboratively to improve the process. The rating section comprises nine Likert items and two open-ended responses. The final version was approved by the faculty senate and was first administered in spring 2013. In addition to the instrument redevelopment, the committees addressed the strengths and weaknesses of the rating scale approach, recommending ethical use of the data for faculty evaluation and professional development. Student responses are anonymous, preventing the identification of any individual. Administration takes place online for all classes, irrespective of modality, managed by the university's information technology unit that provides summary results by course and makes the findings available to the faculty members, supplemented with departmental norms. Instructors and departments make individual determinations about data use, with some using it for promotion and tenure. The ratings are also used in some university faculty awards. The current study is based on the student responses to the instrument from the fall 2017 to the fall 2022 semesters and comprises 2,171,565 observations. Students are asked to respond to each item on a five-point Likert Scale (5 = excellent, 4 = very good, 3 = good, 2 = fair, 1 = poor). See Appendix A for the instrument.

3.2. The Data Analysis Plan

The original protocol called for an analysis of the results for the entire responding student group by computing a total score over the nine items and examining the data. Then, from a measurement perspective deriving indices of internal consistency (Alpha) and item analysis, including difficulty analogs and discrimination [91]. This was to be followed by determining the domain sampling properties of the data using the measure of sampling adequacy [92]. Subsequently, the investigators intended to determine distributional characteristics by computing the moments (central tendency, variability, skewness, and kurtosis). Upon establishing the psychometric adequacy of the data, the objective was to use the total scores as the criterion measure for the differential impact of course modality, college, department, course level, class decile, and pre, during, and post-COVID timeframes, avoiding statistical hypotheses testing because of excessive power. The plan was to assess the differences by computing effect sizes and obtain a consensus about their importance and impact on the instructor evaluation process.

3.3. An Unexpected Anomaly and The Results

The student rating process on university campuses is a good example of a complex system. Forester [93] cautions us that one can never predict how an intervention will ripple through a complex system for instance, moving the rating system online. Also, outcomes will be counterintuitive, and there will be side effects that must be accommodated. That is what happened in this study. Earlier, we indicated that we started by calculating the total scores. That is when the anomaly arose. We noted a disproportionate number of total scores that summed up to 45. For the nine-item instrument, the only way that could happen would be nine responses with ratings of five each. Therefore, this side effect atomized the

focus of the study by creating an emergence encountered in complex systems where the interactions are more meaningful than the individual components. Most likely, this will become a characteristic of contemporary educational and social research. This phenomenon was pointed out in an article by Gündüz and Fokoué [61], where they termed these patterns zero variance. We called this straight lining and followed up by checking the additional total scores of 36, 27, 18, and 9. Obviously, a total score of nine requires responses from all ones. The remaining total scores, 36, for instance, could indicate that a student selected all fours; however, there are multiple combinations of responses that would sum to that value and not indicate zero variance. Therefore, we examined that possibility as well. The result of that research in Table 3 shows that 68% of the over 2 million responses exhibited straight-lining responses. Table 4 shows the percentage of that behavior for each item in the rating scale. Although not 100% for other items (excluding 45 or 1), the percentages are very high. Table 5 shows that by far (70%) the straight-lining involved all 5s, with substantially smaller percentages for the other total scores.

Table 3. Percentage of students who responded identically (straight liners) on the SPI: 2017–2022.

	N	Percent
No	695,528	32.0
Yes	1,476,037	68.0

Table 4. Percentage of students who responded identically (straight liners) for each item on the SPI: 2017–2022 based on total score.

Total Score	45 (5) N 1,034,022	36 (4) N 205,539	27 (3) N 190,327	18 (2) N 53,491	9 (1) N 39,456
Organizing	100	94.9	96.3	93.2	100
Explaining	100	94.6	96.3	92.9	100
Communicating	100	93.9	95.5	91.1	100
Respect and concern	100	96.3	97.0	94.1	100
Interest	100	95.1	96.2	92.7	100
Environment	100	93.3	94.9	90.5	100
Feedback	100	95.1	96.3	92.7	100
Achieve	100	92.9	94.5	89.9	100
Overall effectiveness	100	90.8	93.4	87.7	100

Table 5. Frequency and percentage of students who responded identically (straight liners) on the SPI: 2017–2022.

Score	N	% Straight Line
All 5s	1,034,022	70.1%
All 4s	182,800	12.4%
All 3s	174,828	11.8%
All 2s	44,931	3.0%
All 1s	39,456	2.7%

3.4. A Change in Plans

These findings caused the investigators to abandon the total score as an outcome measure and change to a binary variable—whether students straight-lined or not. Examining Table 3 shows that only 32% of students responded to the items somewhat independently. This could indicate a more considered approach to evaluating their courses, although this is an assumption that has not been verified. But at least they are not straight-lining. This creates a contingency analysis for two categorical variables. Therefore, the relationship index changed to the lambda coefficient [94,95] that assesses the strength of association between two categorical variables, with 1 indicating a perfect relationship and 0 indicating

complete independence. The results of that analysis are presented in Tables 6–11. The lambda value for each contingency table was zero, indicating that none of the independent variables had any impact on whether students straight-lined or not. The behavior was ubiquitous across all aspects of the university. Students straight-lined (zero variance) the rating scale at a ratio of 2 to 1.

Table 6. Percentage of students by course modality who responded identically (straight liners) on the SPI: 2017–2022.

Modality	N	Straight Line %
Reduced seat time mixed mode (M)	207,046	67.3%
Face-to-face (P)	951,287	65.8%
Initial reduced face-to-face (R)	25,308	62.9%
Reduced seat time, active learning (RA)	32,479	63.9%
Limited attendance (RS)	62,210	69.4%
Video streamed with classroom attendance (RV)	16,279	63.4%
Video streamed (V)	51,243	65.6%
Synchronous "live" video (V1)	165,981	68.8%
Online (WW)	659,732	71.7%

Table 7. Percentage of students by college who responded identically (straight liners) on the SPI: 2017–2022.

College	N	Straight Line %
Arts and Humanities	247,173	65.5%
Business	258,828	66.8%
Community Innovation & Education	172,679	73.1%
Education	22,676	66.7%
Engineering & Computer Science	254,170	62.7%
Health & Public Affairs	51,808	75.0%
Health Professions & Sciences	111,450	76.8%
Medicine	77,309	70.3%
Nursing	61,555	74.8%
Sciences	699,005	67.0%
Graduate Studies	1934	68.9%
Nicholson School of Communication & Media	44,519	64.5%
Rosen School of Hospitality Management	75,937	69.6%
School of Optics	3183	57.8%
The Burnett Honors College	2805	57.8%
Undergraduate Studies	14,840	74.4%

Table 8. Percentage of students by department * who responded identically (straight liners) on the SPI: 2017–2022.

Department	N	Straight Line %
Army ROTC	2067	88.5%
Communication	32,960	65.8%
Criminal Justice	40,790	76.1%
Economics	41,010	55.1%
Electrical & Computer Engineering	29,272	58.8%
School of Kinesiology & Physical Therapy	23,951	78.3%
Marketing	28,054	71.3%
Mechanical & Aerospace Engineering	75,152	68.3%
Nicholson School of Communication & Media	51,167	65.5%
Tourism, Events, and Attractions	28,359	68.6%

* A randomly selected subset.

Table 9. Percentage of students by class size decile who responded identically (straight liners) on the SPI: 2017–2022.

Class Size Decile	N	Straight Line %
1.00	221,597	67.3%
2.00	222,634	66.8%
3.00	223,338	67.3%
4.00	220,884	66.9%
5.00	214,709	69.3%
6.00	213,737	70.3%
7.00	222,869	69.9%
8.00	200,981	66.1%
9.00	213,532	66.5%
10.00	216,284	69.2%

Table 10. Percentage of students by course level who responded identically (straight liners) on the SPI: 2017–2022.

Course Level	N	Straight Line %
Lower Undergrad	734,318	66.3%
Upper Undergrad	1,277,164	69.8%
Graduate	156,300	60.9%
Total	2,167,782	

Table 11. Percentage of students pre- and during COVID, who responded identically (straight liners) on the SPI: 2017–2022.

	N	Straight Line %
Pre-COVID	874,945	66%
During COVID	653,662	70%
Post-COVID	642,958	69%

4. What Does This Mean?

4.1. The Three-Body Problem and a Possible Explanation

Obviously, this is an unexpected and concerning finding. Apparently, two-thirds of students (1,476,037) are not engaged meaningfully in the evaluation of their courses. They demonstrate that they have no skin in the game with the straight-line response pattern. Perhaps they view that the opportunity costs of thoughtful responses far outweigh the added value of the process. In focus groups, they reinforce their opinions that they do not see the impact of their responses, although these data can be very high stakes for faculty members. Students express their feelings on social media but seem reticent to express them in the formalized system. However, there is a possible alternate explanation for this behavior. The fact that the predominance of the straight-lining occurs at the excellent level might indicate that this is a comprehensive evaluation of the course and instructor and that the students view item-by-item variable responses as contributing little added value to their end-of-course responses. This would have a significant impact on a comparative metric approach to his information. This is particularly concerning when one thinks about summarizing the data for colleges and departments when most of the students have bypassed the system. This has implications far beyond the hypothetical biases and impacts found in the research literature: modality, student context, instructor context, and validity. Those constructs simply do not apply if students are not engaged in any meaningful way. This is a conundrum. If they are not involved, why? Figure 5 presents a possible explanation cast in the context of the three-body problem. The figure posits the three driving forces in the problem, ambivalence characterized by simultaneous positive and negative feelings about rating their courses. Indifference—defined as being unconcerned or

uninvolved in a particular situation or towards a specific action. Ambiguity—the quality of being open to more than one interpretation or having multiple possible meanings. This occurs when something is unclear, uncertain, or can be understood in different ways, leading to confusion or difficulty in understanding its true intent or significance. The interaction of the three forces produces additional influences. Detached refers to being emotionally disengaged or impartial, often in a situation where meaningful involvement is expected. Apathetic describes a lack of interest, enthusiasm, or concern about something—the absence of motivation to engage in a particular situation or task. Indifference refers to being uncaring and showing little or no reaction towards the things happening around them. Equivocal refers to situations or requirements that can be interpreted in different ways, making it difficult to determine the underlying purpose behind them. This represents a complex pattern of interacting forces that, when considered as a system, hinders students in their attempts to evaluate their courses. With all these elements creating a positive reinforcement cycle, the optimal decision might be just to straight line the rating form.

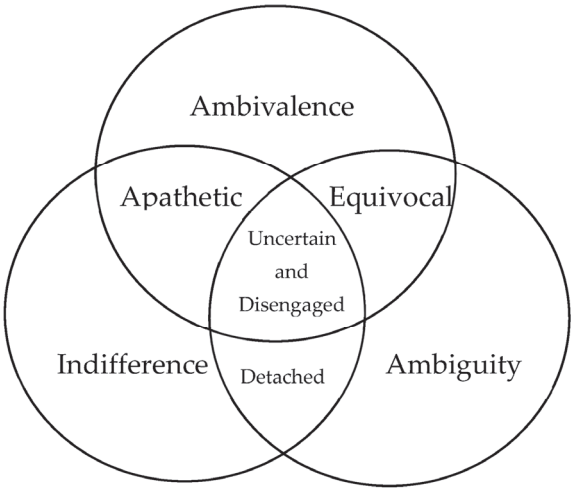

Figure 5. The Three-Body Problem and Student Disengagement.

The elements of the three-body problem are not unique to the evaluation of the course issue. They exist in many contexts: science, society, education, technology, humanities, history, politics, and medicine, just to mention a few. Additionally, these emotional and cognitive states are replete in contemporary and classic literature. For example, consider Table 12, which cites the protagonists in popular works, each one characterizing one of the dispositions in Figure 5.

Table 12. The Three-Body Problems in Literature.

Component	Character	Book	Author
Ambivalence	Agnes	The Old Drift	Namwali Serpell
Indifference	Okonkwo	Things Fall Apart	Chinua Achebe
Ambiguity	Sethe	Beloved	Toni Morrison
Detached	Cora Randall	The Underground Railroad	Colson Whitehead
Equivocal	Ifemelu	Americanah	Chimamanda Ngozi Adichie
Apathetic	Bigger Thomas	Native Son	Richard Wright
Perplexed	David	Giovanni's Room	James Baldwin

4.2. What If Common Sense Does Not Make Sense?

On the face of it, students' ratings of their courses appear to make sense because it can serve as an important feedback mechanism for educational institutions. However,

these assumptions seem flawed when most students are not actively participating in the process. Additionally, ratings can be influenced by personal biases or grievances rather than objective course evaluation. Students may lack the expertise to assess the effectiveness of pedagogical methods or curriculum design accurately. Despite their potential benefits, student rating systems should be viewed in the context of contemporary educational complexity. It may be that commonsense has led us astray.

Duncan Watts' [96] and Daniel Kahneman's [97] thinking offers insights into how student ratings can create biased, inaccurate, and misleading interpretations. Watts' work defining social networks is relevant, showing that course evaluations are not isolated events but are part of a larger network of interactions. The ratings are impacted by forces such as social connections, the instructor's reputation on social media, or commonly held attitudes. Watts' work on perception bias reinforces the argument that individual evaluations could be misleading because a small number of excessively positive or negative impressions may dominate the overall reaction to a course. He would contend that it is crucial to embrace a broader system of interactions and the diversity of approaches to develop a more comprehensive understanding of a course's effectiveness [96]. Kahneman's research on cognitive biases makes a strong case that the availability heuristic influences people's judgments. When they recall one specific positive or negative incident, that recollection will overly influence their general evaluation because an exceptionally enjoyable or frustrating experience will overshadow the overall experience. Additionally, the anchoring effect might impact students' ratings because when they contrast one course to another, an exceptional experience anchors their expectations, unfairly influencing their evaluation of their current course [97]. As suggested by our findings, social desirability bias might well impact how students rate their courses. They will be disposed to assign positive ratings, especially if they see it as the socially acceptable response while deferring on criticism to avoid potential conflicts or repercussions. Perhaps this is why we found 70% all 5 s and less than 3% all 1 s.

4.3. An Evolving Context

So many things have changed since a hundred years ago when educators believed that there would be value in having students rate their courses. At that time, there was only one face-to-face modality; the primary delivery method was the lecture, and the technology of choice was the chalkboard. However, instructional technologies began making their way into classrooms with the to-be-expected furor, but they persisted. Their impact is old news, and by now, the number of higher education course modalities in the digital environment has made the traditional concept of the class, what Susan Leigh Starr has termed a boundary object—strong enough to hold a community of practice together but weak in terms of definition in the larger community although strong in individual constituencies [98]. Without a unified and accepted class model, to what are students responding?

A second contextual issue is the increasing financial and educational inequity in our country. Current data show that if a student resides in the lowest economic quartile, then their chances of obtaining a college degree are eleven percent [99]—the odds against them are nine to one. These are terrible odds. These young people are living a life of what Mullainathan and Shafir [100] call scarcity, where their needs far exceed their resources, causing them to juggle so many things in their lives just to survive—adding college study to that list causes all the dominos to collapse and the optimal decision for them is to drop out with no chance of ever returning. The total accumulated college debt in the country is 1.7 trillion dollars [101]. This is staggering. If that were a gross domestic product, it would be the ninth-largest economy in the world. And it should surprise no one that most of that debt is carried by those in the lowest economic classes [102]. The cost of higher education in the United States denies access to so many. As a result, we are wasting millions of perfectly good minds simply because they do not have access to the resources necessary to succeed. Unfortunately, this inequity and bias have increased run-away decision-making by opaque

and non-transparent technologies with a built-in, programmed bias that makes important decisions about people and their lives. Consider this from O'Neal [103]:

> Nevertheless, many of these models encoded human prejudice, misunderstanding, and bias into the software systems that increasingly manage our lives. Like gods, these mathematical models were opaque, their workings invisible to all but the highest priests in their domain: mathematicians and computer scientists. (p. 3)

OR

> Without feedback, however, a statistical engine can continue spinning out of faulty and damaging analysis while never learning from its mistakes. They define their own reality and use it to justify their results. This type of model is self-perpetuating, highly destructive—and very common. (p. 7)

In addition, there is a distinct college access wealth advantage in this country. A recent *New York Times* article showed that children from wealthy families have a far greater chance of getting into an elite university than their disadvantaged peers, even though their academic credentials are equivalent [104]. The evidence goes even further. Research shows that those affluent graduates have far better access to prestigious jobs simply because of the trailing wind of wealth advantage. Gumbel [105] states:

> Put another way, people from upper-middle-class origins have about 6.5 times the chance of landing an elite job compared to people from working-class backgrounds. Origins, in other words, remain strongly associated with destinations. (p. 13)

OR

> As root a Bourdieusian lens insists that our class background is defined by our parents' stocks of three primary forms of capital: economic capital (wealth and income), cultural capital (educational credentials and the possession of legitimate knowledge, skills, and tastes), and social capital (valuable social connections and friendships). (p. 14)

The Supreme Court recently vacating affirmative action on university campuses caused a vehement backlash so much so that the department of justice launched an investigation into donation and legacy admissions, especially at elite institutions. Consider this quote from a New York Times article by Cochrane et al. [106]:

> With the end of race-based affirmative action, the practice of giving admissions preference to relatives of alumni is particularly under fire at the most elite institutions, given the outsized presence of their alumni in the nation's highest echelons of power. A new analysis of data from elite colleges published last week underscored how legacy admissions have effectively served as affirmative action for the privileged. Children of alumni, who are more likely to come from rich families, were nearly four times as likely to be admitted as other applicants with the same test scores. (para. 8)

This inequity is further reinforced by the recent admission to elite universities scandals [104]. All these events may seem far away from student rating of instruction, but they are not. Consider how underserved students would be equipped to rate their classes and instructors compared to their affluent classmates who inherit a strong sense of agency and entitlement at universities. Jack [107] discusses how first-time college students from underserved communities experience an entirely different institution:

> Some students discover, to their great consternation, that they are also responsible for deciphering a hidden curriculum that tests not just their intellectual chops but their ability to navigate the social world of an elite academic institution, where the rewards of such mastery are often larger and more durable than those that come from acing an exam. (p. 86)

How would you aggregate end-of-course rating data from these two distinct cohorts in a class, and how would you interpret what those data mean?

Finally, the COVID pandemic had and is having a dramatic impact on universities and public schools, where both were forced to not only keep the doors open with virtual education but also attempt to maintain quality. In the initial move to emergency remote instruction when the world locked down, the impact was devastating. The long-term effect is yet to be experienced, but we are already seeing signs of what is to come. A significant segment of the current generation is not including a college education in their post-secondary education plans [108]. Further, this generation is much less prepared for university work than most any other group in recent decades [109]. These contexts have a dramatic impact on how students perceive their higher education: how they experience it, how they react, and how they express their opinions.

4.4. An Idealized Cognitive Teaching Evaluation Model

Figure 6 presents our concept of an effective and supportive teaching evaluation system in contemporary universities. To be sure, this represents a seismic shift in higher education's culture, and for the moment is purely speculative. However, given the dysfunction of the current rating system, change might emerge through:

1. Teaching First Commitment: Dedication to and valuing teaching excellence equally with other academic pursuits by recognizing the influence educators have on students.
2. A Culture of Teaching Effectiveness: A shared commitment to continuous improvement in teaching methodologies, encouraging instructors to adapt according to student needs informed by the scholarship of teaching and learning.
3. Comprehensive Formative Evaluation (excluding summative evaluation): Providing constructive, systematic feedback to instructors through formative assessments rather than using student evaluation for comparisons.
4. Prototype Exemplary Teaching: Celebrating and learning from superior instructors who inspire and engage students, setting a benchmark for instructional excellence.
5. Actionable Teaching Insights: Utilizing research-based insights and innovative teaching methods to bridge the gap between theory and practice.
6. Evaluation-Grounded Feedback: Leveraging student ratings and other evaluation protocols to support professional development.

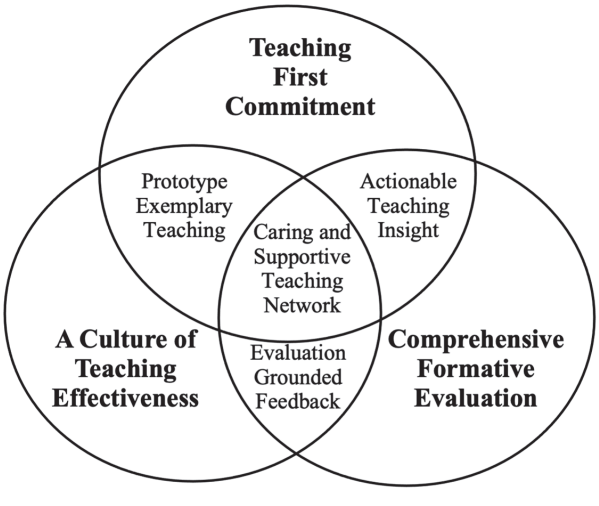

Figure 6. A Three-Body Possibility for Effective Teaching and Evaluation.

The interplay of these elements will establish a Caring and Supportive Teaching Network, fostering an educational community of practice that emphasizes cooperation

and promoting an environment for the personal and professional growth of all involved in teaching and learning. In such a university, a supportive teaching network would flourish, uniting faculty, students, and administration in a shared vision for academic excellence.

In keeping with the theme of this special issue, by asking if online instructional technology offers hope for higher education, the student evaluative voice becomes paramount. Online learning has transformed higher education by accommodating the lifestyles of individuals who are unable to displace themselves to attend on-campus courses typical in traditional education. This transformation has not only made higher education accessible to a broader demographic but has changed the learning landscape from an inward-focused to an outreach model. Digital learning removed barriers that once targeted higher education to a specific population. Now students, irrespective of location or family and work demands, can obtain further education in their own time, space, and motivation levels. As we noted previously, the COVID-19 pandemic demonstrated the value of online learning as a mechanism that was key to the continued functioning of American higher education. As campuses were forced to close their doors, this modality showcased the intrinsic value of being online as an effective, dependable, and flexible means of teaching and learning. By bridging geographical, educational, financial, and societal distances, the new modalities not only allowed American universities to survive the challenges of a pandemic but also simultaneously expanded their educational mission beyond the confines of traditional campuses. Our model, comprising the three primary elements, resonates with technologies that continue to advance as the learning landscape evolves. By harnessing the power of data analytics, fostering open communication, and embracing ongoing assessment, online instructors can create exemplary teaching experiences that empower students to reach their full potential with options such as:

- Content Personalization, enabling instructors to curate material that resonates with individual learners, creating a more engaging experience.
- Adaptive Learning that can dynamically adjust the difficulty and specificity of content and design assessments based on student performance, ensuring that each learner experiences effective learning trajectories.
- Automated Feedback, allowing for real-time generation of constructive information about student progress that enables timely positive learning interventions.
- Learning Analytics that assess knowledge acquisition patterns and create engagement metrics identifying areas of required improvement coupled with appropriate interventions.
- Natural Language Processing chatbots serving as virtual teaching assistants, answering students' questions, and providing guidance 24/7.
- Collaborative Platforms in which online classrooms can facilitate virtual group work, providing discussion prompts and analyzing group dynamics to encourage productive interaction.
- Automated Assessment that handles routine learning metrics, saving instructors time and effort and allowing them to focus more on personalized interactions with students and designing more complex evaluation methods.
- Sentiment Analysis might gauge student attitudes and engagement towards various aspects of the learning experience. This information can be used to tailor support and create a positive online learning environment.
- Large Language Generative AI Models that can enhance higher education by providing personalized learning experiences, customizing educational content, and providing real-time formative learning feedback with AI tutors.

Additionally, blended learning can leverage enhanced presentations by offering virtual office hours, thus enhancing student-centered pedagogy. Blended learning, as a combination of traditional face-to-face and online learning, has become transformative in higher education by maximizing the affordances of both modalities. Students can access course materials online, engage in interactive discussions, and collaborate with their classmates and instructors, establishing an effective support network. In the rapidly evolving educa-

tional environment, blended learning has emerged as a cornerstone of higher education, strengthening digital literacy and information fluency, and preparing students for the demands of our contemporary workforce. This learning innovation not only captures the best of both learning worlds but also supports diverse learning modes and will grow in importance in the coming years, preparing students to succeed in our knowledge-driven world [110].

As digital learning continues to evolve, its integration into traditional universities will become more seamless and impactful. However, it is essential to acknowledge that the successful integration of online learning into student evaluation of their courses requires careful planning, faculty training, and support from university administration. As learning continues to evolve, online education can become an effective platform for student evaluation by enabling a valid student voice in higher education.

In effective university environments, while research undoubtedly holds great significance for advancing the boundaries of human understanding, teaching emerges as an equally critical pillar deserving equivalent support and recognition. By creating a culture that values and supports both endeavors, universities can fulfill their transformative potential that is so vital in this technologically driven world, cultivating well-rounded scholars, both students and faculty empowering the coming generations with the knowledge and skills to make a meaningful impact on society. Of course, this change faces obstacles requiring formidable work, effort, and commitment—Muhammad and the mountain come to mind. Unfortunately, there is no Maxwell's demon to eliminate the friction. However, if we address the adjacent possible, the next reasonable first step, we will begin the journey. As Gwyn Thomas said, "the beauty is in the walking—we are betrayed by destinations". If this is quixotic, then bring on the windmills and let us continue our search for Dulcinea of Toboso.

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Appendix A

Student Perception of Instruction

Instructions: Please answer each question based on your current class experience. You can provide additional information where indicated.

All responses are anonymous. Responses to these questions are important to help improve the course and how it is taught. Results may be used in personnel decisions. The results will be shared with the instructor after the semester is over.

Please rate the instructor's effectiveness in the following areas:

1. Organizing the course:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

2. Explaining course requirements, grading criteria, and expectations:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

3. Communicating ideas and/or information:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

4. Showing respect and concern for students:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

5. Stimulating interest in the course:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

6. Creating an environment that helps students learn:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

7. Giving useful feedback on course performance:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

8. Helping students achieve course objectives:

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

9. Overall, the effectiveness of the instructor in this course was:

(a) Excellent (b) Very Good (c) Good (d) Fair e) Poor

10. What did you like best about the course and/or how the instructor taught it?

11. What suggestions do you have for improving the course and/or how the instructor taught it?

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Article

Digital Learning Transformation in Higher Education: International Cases of University Efforts to Evaluate and Improve Blended Teaching Readiness

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Abstract: The global pandemic of 2019 brought heightened awareness to institutions of higher education of the need to engage in a digital transformation that extends beyond university business operations to the pedagogy of the classroom. This paper is a case study that explores three international cases of universities in Colombia, Brazil, and Mongolia that are at different stages along the path of a digital pedagogical transformation. This article tells each story, including (1) what is driving the local need to engage in digital transformation, (2) what the major challenges and barriers are to achieving a transformation, and (3) what efforts are being made to help each university to move along the path towards adoption and change. It concludes with discussing three major themes that emerged from the case studies: (1) the role of local policy in shaping digital transformation, (2) the importance of developing human capacity with technology, and (3) the potential for digital transformation to bring hope.

Keywords: digital transformation; blended learning; higher education; information & communication technology

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1. Introduction

The last several years have introduced an unprecedented level of exploration with information and communication technology (ICT) in higher education around the world, particularly related to the implementation of blended and online learning [1]. The narratives around this digital transformation of higher education have been both positive and cautionary. Higher education (HE) leaders have observed the steady growth of online and blended modalities at their institutions and have recognized the potential for educational access to expand in significant ways. At the same time, the widespread expansion of ICT use during the COVID-19 pandemic uncovered significant issues related to equity and quality.

Prior to the global pandemic, online learning was already becoming mainstream in higher education within the U.S.; both undergraduate and graduate online learning were experiencing upward growth trends in both public and private institutions of higher education, with almost a third of graduate students enrolled in fully online courses [2]. In the U.S., blended learning, defined as the combination of in-person and online instruction [3], was also "on the rise at colleges and universities" [4] (p. 9) and was considered by some to be the "new normal" for higher education [5].

Worldwide conditions in early 2020 led to the closure of institutions of higher education (IHEs) in 185 countries, affecting over a billion and a half learners, according to a report of The United Nations Educational Scientific and Cultural Organization (UNESCO) [6]. This forced about two thirds of IHEs to move to remote teaching and learning, while the other third suspended or canceled most learning activities. One year into the pandemic, 89% of global IHEs had been able to transition to remote teaching [7]. Joosten et al. summarized it as follows:

> "While many of us through the years have experienced and witnessed the potential of blended (or hybrid) learning in the future of postsecondary education, the promise has never been more realized than in the world's response to a global pandemic and the urgency for academic continuity through emergency remote instruction that required online learning technologies to mix or replace students onsite experience with a new online experience" [8] (p. 5).

Although the transition to emergency remote teaching taught us about the possibilities for increasing access to quality higher education [9], it also raised an awareness of many challenges to providing excellent and equitable learning experiences in existing higher education systems [10]. Digital transformation in the educational context is frequently limited to the implementation of digital technologies without pedagogical and organizational changes [11]. In this way, Gkrimpizi et al. [12] classified the barriers related to digital transformation in education in six categories: environmental (legal issues and financial investments), strategic (institutional policy, strategic, and action plans), organizational (coordination between departments and agility), technological (IT infrastructure, security, and privacy risks, integration of digital technologies in educational systems), people-related (digital literacy, resistance to change and risk aversion, lack of time due to workload of academic staff), and cultural (attitudes, beliefs, and a conservative and bureaucratic culture). Petterson [11] conceptualized digitalization in the educational environment at four levels. At the first level, digitalization consists of new digital tools supporting previous practices; at the second level, there is the implementation of new digital tools without changes to teaching and learning practices. At the third level, the implementation of new digital tools occurs with the development of new teaching and learning practices, and on the fourth level, digitalization takes place by modifying the teaching and learning practices and the organization of the entire institution.

On the other hand, technology itself does not result in development in education practice [13,14], and students' learning plays an important role in innovation in higher education [15]. In this regard, several studies have investigated factors related to the pedagogical aspects of digital transformation. For instance, Quaicoe et al. [16] articulate a model for digital transformation in primary and secondary schools that centralizes pedagogical learning, literacy, and life skills, among other factors. Additionally, Borup et al. [17] developed the Academic Communities of Engagement (ACE) framework, which consists of affective, behavioral, and cognitive engagement factors. The ACE framework also describes two types of communities of support for student engagement, the personal and the course communities that can span both digital and in-person learning environments. Another framework constructed to support computer-mediated communication, particularly in blended learning environments, is the Community of Inquiry that consists of a group of individuals who collaboratively engage to construct meaningful learning through three elements: social, cognitive, and teaching presence [18,19].

Considering the factors related to the implementation of digital technologies in higher education, this paper is a case study and shares the experiences of three international universities (in Mongolia, Colombia, and Brazil) that are experiencing a digital transformation and grappling with all of the related issues. A focus of this study is to "consider whether online technology can serve as a vehicle of hope for higher education to improve instruction" [20].

2. Methodology

In this study, three universities were invited to discuss their local experiences, considering cultural aspects and context related to the ongoing digital transformation underway in their institutions. A common link between each of these institutions is that they considered blended learning to be an important part of their future trajectory and reached out to the lead author to collaborate because of his past experience with blended learning.

The universities were asked to consider the following topics:

(1) What is driving the local need to engage in digital transformation;
(2) What the major challenges and barriers are to achieving a digital transformation;
(3) What efforts are being made to help each university to move along the path toward adoption and change.

Below is a brief introduction of each of the institutions.

- Mongolian University of Science and Technology (MUST), Mongolia—MUST is a large public university in Mongolia with approximately 15,000 students. They are leaders in digital transformation in the region. They received a UNESCO-ICHEI pilot grant that enabled them to provide professional development in blended teaching for training 65 national master teachers, as well as cascading training at five other national universities.
- Universidad Autónoma de Bucaramanga (UNAB), Colombia—UNAB is a private university in Colombia with a student population of approximately 10,000. With the onset of the global pandemic, university leaders realized that the institution needed to increase its capacity to deliver quality digital learning. A collaboration with the lead author was begun to look at institutional support for student engagement in their online and blended course offerings [21,22]. Simultaneously, the university president was taking a leadership role in the International Association of University Presidents who were exploring issues of digital transformation. Findings from the institutional exploration of student engagement led to a Fulbright Specialist visit in 2022 and important leadership conversations that have resulted in positive changes at the university.
- Pontifícia Universidade Católica do Paraná (PUCPR), Brazil—PUCPR is a large private university in Brazil with a student population of approximately 40,000. Stakeholders at the university were particularly interested in strategies for improving the experiences of their fully online students. They reached out to the lead author to help with a university exploration of personal and institutional barriers to students being able to fully engage in their online learning experiences [23].

We understand that it would take volumes to document everything that is happening related to digital transformation at these institutions, so we have made our best efforts to organize our limited space around three important questions and the institutions' related experiences.

Finally, in the discussion, we asked the institutions to reflect on the primary question of this study: whether or not online technology is serving as a vehicle of hope for improved instruction at their institutions.

3. Case 1: Mongolian University of Science and Technology

This case study strives to exemplify the current status of digital and online learning, challenges and barriers, and future perspectives on educational digital transformation at the Mongolian University of Science and Technology (MUST), which is the largest national institution of higher education (IHE) in the engineering and technological field, with about 15,000 students and 800 faculty members (2020–2021 academic year statistics). MUST is also a leading institution in information communication technology (ICT); thus, it can be understood that the institution has a duty and responsibility to develop ICT-enabled education toward accelerated digital transformation in Mongolian HE [24]. Therefore, this

case study demonstrates not only institutional but also national status in transforming digital learning in the HE sector.

3.1. Drivers for Digital Transformation (MUST)

Online and digital learning is a promising and inevitable cost-effective educational model for Mongolia with its vast territory and sparse population, where the main challenge for the Mongolian HE system is the provision of service in remote and rural areas. Therefore, digital transformation is very important and urgent in the post-COVID situation to ensure inclusive, equitable, and quality education in Mongolia [25]. From 2000 to 2010, the Mongolian government made significant efforts to establish ICT infrastructure for digital learning under the umbrella of the "Distance education national program 2002–2010" and the "E-Mongolia National Program 2005–2012". Recent government initiatives such as "Vision 2050" and "Digital Nation" put more attention on the importance of developing digital educational content, open education resources (OERs), and MOOCs in order to fully transfer all levels of education into e-learning programs [26].

The use of digital technology in education has been highlighted as an opportunity to innovate and increase the quality of the educational systems. It is also promoting open education that can be defined as a learning experience that provides a great degree of flexibility in the choice of topic, place, speed, and method to the learner. Therefore, digital learning transformation removes entry barriers to education, increasing access to knowledge, promoting personalized and self-directed learning, and supporting lifelong learning. Also, the promotion of digital transformation in education is crucial to enhance the quality of Mongolian HE as well as an important strategy to achieve United Nations Sustainable Development Goal 4 (SDG4) [27].

There are several policy drivers of digital transformation in the Mongolian HE sector. The first phase (2021–2030) of the Vision 2050 long-term development policy was declared as a phase in which all citizens shall be provided equal opportunity to access quality education, reforming an inclusive education system [28]. To promote lifelong learning opportunities for all citizens afforded, regardless of time and location, it is also planned to strengthen lifelong education through the development of open education systems and a national-level integrated platform for online training. The Ministry of Education and Science of Mongolia approved the "Education sector mid-term plan 2021–2030" that outlined three main objectives in HE. Objective 5.2 (access) clearly sets to increase equal access to higher education through the promotion of flexible learning pathways and an open education system and it is expected that open, online, and distance learning modalities will have been expanded [29]. These policy guidelines, education sector objectives, and government initiatives are stimulating and requiring every IHE in Mongolia, including MUST, to accelerate digital transformation in their teaching and learning process.

3.2. Challenges and Barriers to Digital Transformation (MUST)

For Mongolia as a developing country, we can identify a number of challenges and obstacles to educational digital transformation, such as ensuring the sustainability of ICT infrastructure [27], limited options for digital contents and OERs [30], the early development state of the MOOC concept [25,31], internet connection problems in rural areas, and many more. For HE, Mongolian students are fully aware of the advantage of online and blended learning (BL) and the opportunities provided by digital transformation, and students are confident about their ICT skills [32]. However, the main problem for digital learning was the lack of teachers' digital competencies [33]. A recent policy review by UNESCO identified two main issues in Mongolian HE related to teachers' professional development that hinders digital transformation. These are (1) the need to mainstream ICT competency standards for HE teachers and (2) the limited opportunities for teachers to find advanced professional development training [27]. Specific recommendations and the ICT training needs of HE teachers were also provided in the policy review. Just before the COVID-19 pandemic, we conducted a survey to identify professional development

needs in digital learning from 436 teachers at the top five national universities in Mongolia (Figure 1). The result clearly revealed that there is a significant need to strengthen teachers' use of ICT technology in education (43.8%), as well as enhance digital pedagogy (48.6%), digital content development knowledge (47%), and skills in digital assessment (41.3%). The data showed that teachers were less interested in MOOC development (25%).

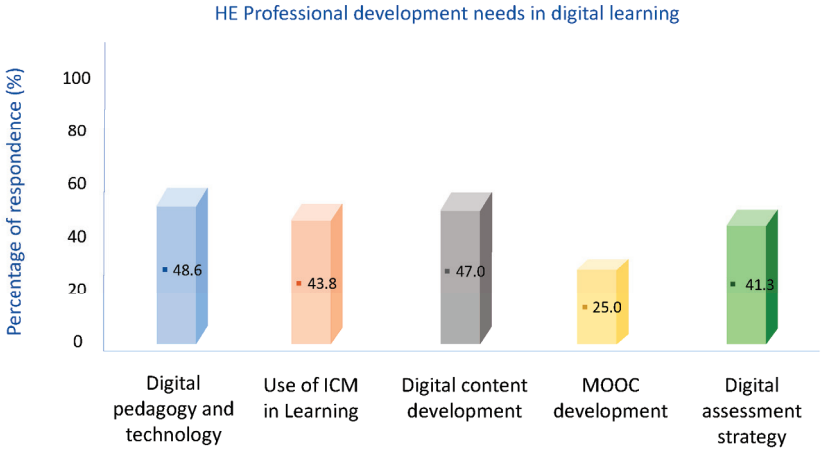

Figure 1. Professional development needs in digital learning of top national universities in Mongolia.

The learning management system (LMS) plays an important role in the quality of online learning and BL. MUST started to develop an ICT-driven learning platform in 2002, and its functionality has grown over the last 20 years (Figure 2). However, we learned that a locally developed LMS was not sufficient for quality online or digital learning when we faced the COVID-19 pandemic situations due to its (1) inability to provide interactions in a synchronous modality, (2) inadequate digital assessment and social annotation tools, and (3) absence of learner content as well as learner–teacher interaction functionality. Therefore, MUST started to use the Microsoft 365 software, especially the MS Teams program, as an online learning platform, and is still using it in post-COVID online learning. In the early adaptation stage of MS Teams, the software was challenging for students, required a high cost for data usage, and was difficult for teachers to manage online courses [33]. Since the local LMS was not sufficient for online learning and BL, and also because MS Teams alone could not fulfill the needed administrative or management functions, MUST needs to make a decision about whether to continue to upgrade its current LMS functionality or integrate it with already developed online learning platforms.

3.3. Efforts Moving towards Digital Transformation (Mongolia)

MUST established an Open Education Center (MUST-OEC) in 2019 that has acted as a trailblazing institution in the digital transformation of Mongolian HE. The MUST-OEC is a premier academic institute devoted to the academic study of education policy, educational technology, ICT-driven learning, open education through dialogue and exchange ideas, research and innovation, and engagement with national and international institutions, scholars, teachers, instructional designers, and practitioners [34]. During the pre-COVID period, the MUST-OEC efforts put more attention on increasing the awareness of digital transformation and the concept of open education in the Mongolian HE sector. The following five training modules were developed and conducted: Open Education, Open Educational Resource, Instructional Design, Heutagogy, and Massive Open Online Course. The MUST-OEC was the first institution in Mongolia to introduce the concept of "Education 4.0", which describes the future of education as using advanced technologies and automation. About 300 representatives from the Ministry of Education and Science, the

Institution of teacher professional development, and more than 15 universities located in Ulaanbaatar participated in all five series of training in a face-to-face format. These training series were further organized in an online format to the Mongolian National University of Education, which is the biggest university for educating K-12 teachers [25].

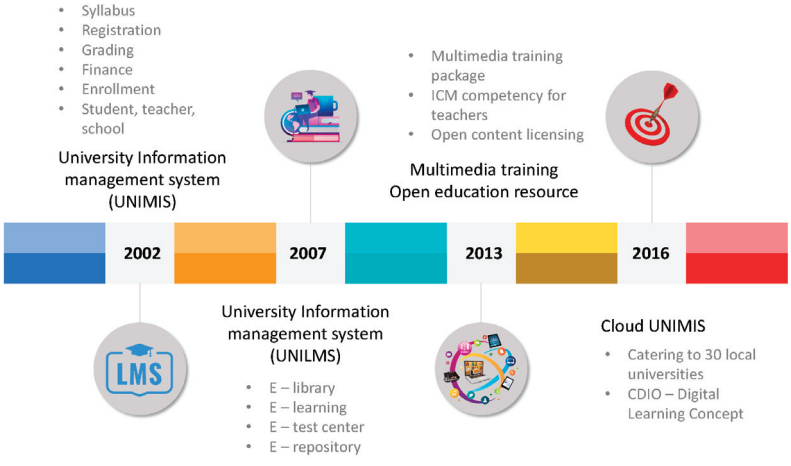

Figure 2. Development of a learning management system (LMS) at MUST, Mongolia.

The MUST-OEC could develop several benchmark MOOCs for all stakeholders in the HE sector based on the funding sources of Asian Development Bank and the Ministry of Education and Science. The "Open Education" MOOC was developed based on the previous face-to-face and online training materials. For instance, the "Higher Education Governance and Management" MOOC together with motivational webinar training could have delivered state-of-the-art knowledge to the decision makers at the Ministry of Education and Science and the management-level people at every IHE in Mongolia. The MUST-OEC developed and implemented a MOOC entitled "Teacher Professional Skill Development" during COVID-19 school closures, which provided a notable impact addressing the pandemic situation [33].

To accelerate digital transformation as well as to overcome the pandemic successfully, the MUST-OEC proposed an "Online Professional Development Program" and implemented nationwide online training for HE teachers in collaboration with the Institution of teacher professional development of Mongolia. More than 1500 higher education teachers (which is about 20% of HE teachers in Mongolia) were directly trained through an online professional development program. For MUST, more than 700 teachers participated in the training program. More detailed information about the implementation success and lessons learned in the online professional development program for mass university teachers during COVID-19 can be found elsewhere [33]. Now, the online professional development program is being used in pre-service teacher training at MUST.

Recently, the MUST-OEC focused on international outreach and networking to accelerate digital transformation in HE. MUST is now a member of international communities and networks, including J-WEL led by MIT [35], the Global MOOC and Online Education Alliance (GMA) led by Tsinghua University, and the International Institution of Online Education (IIOE) led by UNESCO-ICHEI. MUST could have established the IIOE national center in Mongolia. Being a member of these specific communities brings a number of benefits, including the collaborative development of online professional development platforms (https://www.iioe.org/, accessed on 18 October 2023), the opportunity to engage in continuous teacher training programs, knowledge sharing, online learning infrastructure development [36], and project funding. For instance, funded by UNESCO-ICHEI, the MUST-OEC successfully implemented the "Blended Learning Capacity Building for STEM

Teachers" pilot project in Mongolia [33]. The pilot project aims to empower Mongolian HE teachers with competency and skills in blended learning (BL) and support development for related policies by carrying out a training program on BL for master teachers, conducting university-wide BL practices, and developing a BL assessment tool and guidelines for BL course development. The BL master teacher training was implemented in the form of a blended format for selected outstanding teachers from six national universities. During the training, an international expert delivered five modules related to BL concepts with live interpretation. Overall, 65 national-level master teachers were prepared and certified. After the BL master teacher training, six national universities also organized cascading training in their respective institutions and involved 257 teachers in total [33].

4. Case 2: Universidad Autónoma de Bucaramanga, Colombia

Universidad Autónoma de Bucaramanga (UNAB) is a private, not-for-profit higher education institution located in northeastern Colombia. It has an academic offering of 109 programs at the undergraduate and graduate levels, organized into six colleges: Economics, Administrative, and Accounting Sciences; Social Sciences, Humanities and Arts; Legal and Political Sciences; Health Sciences; Engineering; and Technical and Technological Studies. Although it delivers most academic programs in person, the university has a strong tradition of online programs, as well as cross-curricular activities aimed at fostering creativity, entrepreneurship, and leadership in its alumni. With a population of 10,039 students and 452 full- and part-time teachers, UNAB seeks to transform its offer toward blended learning, building on the good practices acquired during and after the COVID-19 pandemic. The goal is to have flexible and adaptable academic environments enhanced by technology and to provide learning experiences that strengthen students' engagement and success, particularly for those with a lower socioeconomic status.

4.1. Drivers for Digital Transformation (UNAB)

Currently, UNAB's student population is composed of 5860 women and 4179 men. Regarding trends in the last five years, the online enrollment has increased from 2439 in 2018 to 2571 students in 2023, while the in-person enrollment has decreased from 9190 to 7468. Of the total of 109 programs, the online academic offer is represented by 16 programs, seven at the undergraduate level and nine at the graduate level. The online modality currently accounts for 14.6% of the programs at UNAB, which in turn serves 25.6% of the total student population. Like many other universities at the global level, UNAB went through a post-COVID strategic readjustment. This readjustment can be summed up in a new value proposal comprising five elements, shown in Figure 3.

This new strategy and value proposal has defined several transformational challenges, including one entitled the "UNAB Hybrid Campus", which refers to flexibility and a combination of modalities, skill upgrades, and technological and infrastructure development. Therefore, it is expected that the institution will concentrate its efforts on digital transformation in 2024 and the years to come.

An external driving force prior to this institutional reflection process was the coordinated actions that the Ministry of Education of Colombia started during the pandemic through the "Plan Padrino" program, which evolved into the Educational Innovation Lab for Higher Education (CoLab). "Plan Padrino" was a mentoring program where experienced universities helped small-sized institutions to navigate the challenges that emerged with remote teaching during the mandatory lockdown of COVID-19. UNAB actively participated in this program, assisting colleges in northeastern Colombia. For its part, in 2022, CoLab launched an "Instrument to Measure Variables of Educational Innovation and Digital Transformation in Higher Education", inviting UNAB to be amongst the first institutions to apply such a methodology.

Figure 3. UNAB's post-COVID strategic readjustment: value proposal elements.

The instrument induced a self-critical reflection on the following dimensions: (1) Strategic Management for Educational Innovation and Digital Transformation; (2) the Planning and Management of Academic Digital Ecosystems; (3) the Management of Innovation in Teaching; and (4) the Management of Comprehensive Student Accompaniment. On a percentage scale, the average score obtained was 69.5%, with the highest score being the Management of Innovation in Teaching (78%) and the lowest score corresponding to the Management of Comprehensive Student Accompaniment (53%).

In conclusion, the external drivers for UNAB's digital transformation are global trends, government's public policies, a national education ecosystem, and the increasing competitiveness in higher education. The internal drivers are the commitment to strategic redefinition, quality assurance, and accreditation, as well as an institutional ecosystem devoted to innovation and represented by divisions such as UNAB Creative, UNAB Virtual, and information and communication technology, among others.

4.2. Challenges and Barriers to Digital Transformation (UNAB)

The main barrier and challenge for digital transformation at UNAB has been inadequate planning and the implementation of different efforts and initiatives throughout the years. Even if the macro-institutional strategy is revised and updated according to trends, any digital transformation requires meticulous planning and continuous follow-up to navigate the inherent challenges effectively. In the case of UNAB, planning and implementation has not been consistent, sometimes resulting in ill-defined strategies and an incomplete understanding of the university's unique needs. Therefore, certain compatibility and communication issues among various systems have arisen, resulting in duplicated efforts and difficulties in accessing and sharing crucial data.

The main information systems currently used at UNAB are Ellucian Banner ERP (enterprise resource planning), SARA human resources manager, the Canva and Moodle LMSs (learning management systems), Simplicity CRM (Simplicity customer relationship management), Alfanet Document Management, Pure RIMS (Research Information Management System), and, more recently, Ufaculty (Faculty Information System).

Planning and implementation are also influenced by a complex decision-making process, since data management and analysis are still precarious at UNAB. Although some advancements have been made regarding the use of control panels and other tools such as Power Bi, there is very little use of large-scale data analysis that shows the evolution and

impact of digital transformation and how it can be quantified. The challenge is to focus on the right processes and put the data into action to appreciate their value and determine their quality.

Another barrier present is the resistance to change. Although UNAB has had a long tradition of commitment towards innovation, insufficient training might have negatively impacted user adoption. A large portion of faculty and staff members still exhibit resistance due to concerns about the potential disruption of established routines and teaching methodologies. Other factors contributing to a resistance to change are the fear of an increased workload or a perceived loss of autonomy and independence. To a lesser extent, another challenge is financial, since investment in technology is expensive and, as a private university, it must be covered exclusively by revenue from tuition payments.

In conclusion, and in order to ensure a successful transition towards digital transformation, a well-structured roadmap should be devised, encompassing a comprehensive assessment of current processes and a clear articulation of goals. The roadmap should move towards integration and more holistic insights, providing a unified user experience and engaging stakeholders in the overall process.

4.3. Efforts Moving towards Digital Transformation (UNAB)

Recent efforts towards digital transformation at UNAB can be explained from two approaches. The first approach is related to institutional adjustments to guarantee academic continuity during 2020 and 2021 amid the mandatory lockdown and other government guidelines to navigate the COVID-19 pandemic, and the subsequent strategic commitment towards blended learning. The second approach is related to recent improvements in physical and technological infrastructure.

Under the first approach, several efforts can be highlighted. First of all, there is faculty training and mentorship, which evolved from a technological immersion plan to the measurement and enhancement of digital skills. In 2021, UNAB adopted the digital competence framework promoted by the Ministry of National Education (MEN) and a self-assessment was applied through a tool developed by the Joint Research Center (JRC) of the European Commission, in collaboration with MetaRed Colombia. The results obtained correspond to 459 systematized responses, with an average score of 55.74 out of a maximum of 88. This average score corresponds to the Expert B2 level of the Common European Framework [37].

Based on this initiative, a training plan was launched during the inter-semester period entitled "Digital Competences for 21st Century Teachers", which included 44 training actions in three different complexity levels (explorer, integrator, and innovator) to cover the following digital competences: technological, pedagogical, communicative, research, and management. In total, 452 people, between teachers and administrative staff, were certified under this plan.

In 2022, a second self-assessment in digital skills was applied, resulting in 477 responses with an average score of 83.4 out of 150. This score corresponds to the Leader C1 level (Common European Framework), demonstrating progress in the mastery of digital and pedagogical skills among UNAB's faculty. During the inter-semester period, the training plan was called "Quality and Innovation in Different Modalities", with 66 training actions equivalent to 350 h, covering the same five digital competencies and issuing 956 certificates to teachers and administrative staff.

Another aspect that stands out related to faculty training and mentorship are the efforts towards the recognition of pedagogical innovations, aimed at teachers who had developed such actions with tangible results. In 2022, a total of 142 teachers submitted their documented innovations, which were made visible through videos in CoLab's platform of the Ministry of Education and in the institutional repository.

The second effort to be highlighted under this approach is the need to explore and implement actions towards student engagement and success in online and hybrid learning environments. Therefore, in 2021, a project was developed in collaboration with a scholar

at Brigham Young University in the USA, to evaluate the level of support provided to students with affective, behavioral, and cognitive engagement in their online and blended learning experiences.

The Academic Communities of Engagement (ACE) framework [17,38] was used as a lens for understanding the types of support that institutions should provide in online and blended learning programs. Using a survey instrument sent to both undergraduate and graduate students (n = 1295), a mixed-methods analysis was conducted to better understand how UNAB students feel their institution supports engagement and what barriers they experience. To accomplish this, the following research questions were addressed: (1) How do students feel the institution supports their academic engagement for online and blended learning (including affective, behavioral, and cognitive dimensions)? (2) What are the barriers to student academic engagement for online and blended learning at the institutional level?

The results showed that 31% of students reported that they experienced three or more barriers to their learning, which should be addressed when considering institutional support elements. Particularly, these barriers refer to economic issues that challenge the daily commute to campus, or the inflexibility of academic schedules that makes it hard to combine work and study. The results of the study were published in the Special Issue "Embracing Online Pedagogy: The New Normal for Higher Education", from the *Education Sciences* journal [21].

During the months of October and November 2022, UNAB was a beneficiary of the Fulbright Specialist program from Fulbright Colombia, in order to have Dr. Charles Graham's support to follow up on the student engagement research study, work towards blended learning readiness, and help design a Teaching and Learning Center at UNAB. Additionally, more than 150 teachers benefited from Dr. Graham's training sessions, improving their experience in digital teaching and awareness about the engagement and commitment of students.

The second approach of physical and technological infrastructure improvements can be summed up in the recent adaptation of 111 classrooms with ICT tools for hybrid lessons, in addition to the ongoing maintenance and upgrade of virtual courses and programs delivered through the Canva and Moodle LMSs. Also, six services were digitized to continue supporting students in their access to education. A total of 78.2% of student services are currently digitized, including student elections, enrollment, and credit and financial processes.

Other tasks being digitized cover electronic payroll transmission, electronic invoices, and mass billing. An overall technological renovation of computer labs is underway. These labs are assigned 100% for student use, and such a renovation also implies the upgrading of computers for teachers and administrative staff.

Finally, and resulting from the post-COVID strategic readjustment mentioned above, UNAB has recently started the reorganization of its academic structure. Academic support areas are being strengthened, and two divisions have been formalized: a Teaching and Learning Services office and a Student Success office. Therefore, it is expected that such an organizational framework will play a pivotal role in driving digital transformation, yielding benefits for both students and teachers.

5. Case 3: Pontifícia Universidade Católica do Paraná

The Pontifical Catholic University of Paraná (PUCPR), established in 1959, enrolls approximately 40,000 students and employs 1500 faculty members across 76 on-campus and online undergraduate programs, as well as 16 postgraduate programs spanning disciplines such as medicine and health sciences, engineering, computer science, law, business, arts, communication, design, architecture, agriculture, veterinary science, and biotechnology. The institution operates across three campuses, situated in the cities of Curitiba, Londrina, and Toledo, all located within the state of Paraná in southern Brazil. Originating within an analog and in-person framework, the university has embarked on its digital transformation

journey in response to the growing prominence of online activities within on-campus programs, alongside a nationwide expansion of online undergraduate and postgraduate education, as expounded upon in the forthcoming sections.

5.1. Drivers for Digital Transformation (PUCPR)

The growth of enrollments in distance education for undergraduate and specialization courses, along with the increase in online activities in face-to-face courses, authorized since 2001 by Decree No. 2253 of the Ministry of Education [39], have been the major forces driving the need for digital transformation in PUCPR. The digital transformation has been led by the administration, considering market demands, especially those stemming from students' needs for greater flexibility of time and space and the growth of enrollments in online degree programs, which require educational technologies for their operation. In Brazil, distance education began in 1996 through Law No. 9394 [40], which allowed the establishment of fully online degree programs. Since then, there has been a significant increase in enrollments in online degree programs within the country, offering lower costs and high flexibility for students (Figure 4) [41].

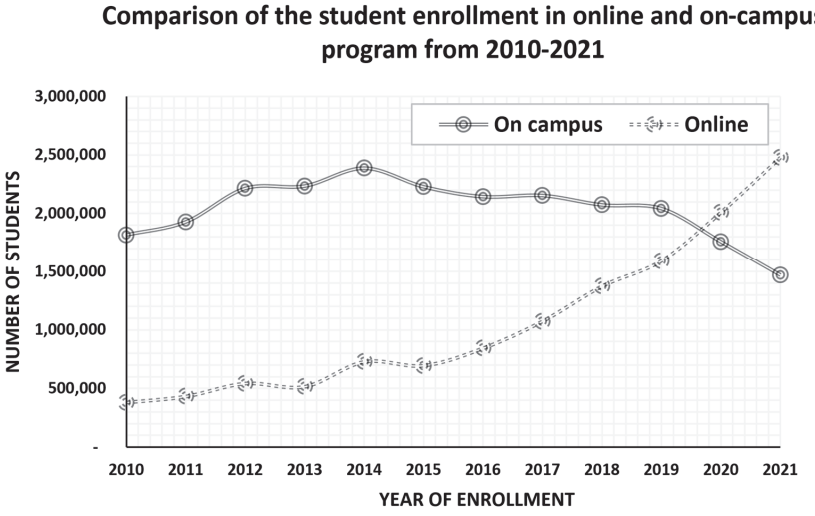

Figure 4. Increase in online course enrollment compared to on-campus enrollment from 2010 to 2021 [41].

Post-COVID, the demand for digital transformation among students in face-to-face programs increased as they became more familiar with synchronous remote classes and the use of learning management systems (LMSs). Many of the students and professors in face-to-face undergraduate and graduate programs rarely used the LMS, which had been available since 2002. Eureka, developed in partnership with Siemens for online professional training courses, started to be used as an LMS for graduate courses and for face-to-face undergraduate students to take dependency subjects online [42]. Eureka was discontinued in 2015, and the institution began subscribing to commercial LMSs, eliminating the need to maintain a team for software development and support.

Brazilian legislation that regulates the modes of education classifies higher education programs into two categories: face-to-face or online. There is no regulation that includes blended learning. In 2001, the Ministry of Education, through Decree No. 2253 [39], allowed the offering of courses that, either in whole or in part, used a "non-face-to-face" method with a limit of 20% of the total program workload, using integrated information and communication technologies to achieve pedagogical objectives. This opened the possibility

for online activities in face-to-face courses, placing an initial legal demand for the use of tools for organized and didactic online communication between students and teachers.

In 2007, Decree No. 3 from the Ministry of Education established that the measurement of the minimum workload for undergraduate programs should be delineated in hours (60 min) of academic activities and effective student work, rather than in class hours (45 to 50 min), the method previously used in Brazilian higher education institutions [43]. The effect of this resolution on higher education institutions was the need to extend the academic calendar for many of their programs, which reached 40 weeks per year, making several activities carried out between semesters unfeasible, such as teacher training, short-term courses, internships, and research internships. To reduce the annual length of the academic calendar, and considering the regulation described above, PUCPR implemented online activities in face-to-face undergraduate programs in 2014. The effective student work would complement the hours of face-to-face classes, understood as a set of extracurricular complementary activities carried out by students and supervised by teachers through the LMS, within the legal limit of 20% of the program's workload [44].

One cannot overlook the COVID-19 pandemic as one of the drivers of digital transformation in the institution. The fact that professors in face-to-face programs were already using the LMS before the COVID-19 pandemic contributed to the continuity of classes during the period when the institution adopted emergency remote teaching for all of its undergraduate and graduate programs within a week. The institution's Teaching and Learning Center (CrEAre) conducted many training sessions and published pedagogical support materials, especially on techniques for student engagement as well as the assessment of learning in remote classes, the use of the LMS, web conferencing tools (with which professors were less familiar until then), and other educational technologies that contributed to collaboration and student activity during classes. With the possibility of a gradual return to in-person classes in 2021, and due to strict biosafety and social distancing regulations, CrEAre developed a pedagogical support manual and conducted training using blended learning concepts. An adapted Hyflex model was adopted, in which some students attended classes in person, while others had the option to attend classes remotely, either live or recorded.

5.2. Challenges and Barriers to Digital Transformation (PUCPR)

The top challenges that PUCPR faces in the process of digital transformation are related to the traditions of transmissive learning, to technology issues, and also to some political challenges. It is observed that teachers still carry with them the tradition of transmissive teaching through which they were trained, and possess limited digital competencies. For instance, teachers encounter challenges in applying the principles of blended learning or communities of inquiry, and in integrating educational technologies into their classes as tools to promote student collaboration or enhance feedback. Students, in turn, who are still largely accustomed to transmissive teaching, aspire to reduce the number of in-person hours in their courses and increase schedule flexibility by incorporating more online activities.

In online undergraduate programs, it has been observed that many students come with an expectation of synchronous remote classes, maintaining direct contact with the instructor, similar to what transpired during the pandemic. However, they become disillusioned upon encountering entirely asynchronous activities. The institution attempted to introduce some in-person classes into online courses, but this effort was hampered by low student participation in these in-person sessions and a lack of integration between the online and in-person course components. Students express a desire for interaction with instructors in asynchronous online environments and struggle with independently organizing their studies [23].

Technologically, there are barriers such as the lack of homogeneity in the quality of campus Wi-Fi signals, which necessitates constant investments and annual monitoring by means of satisfaction questionnaires responded to by students and professors. The

institution also faces challenges in making necessary investments to keep equipment like laptops and tablets updated and in sufficient numbers for all students to use during classes. Few students bring their own devices to classes, and not all have access to computers at home. Several students exclusively use smartphones to access the learning management system (LMS), virtual library, or applications used by professors in the classroom. Each professor procures their own subscription to collaboration, quizzes, or game applications, typically utilizing the free version. Subscribing to applications for the entire university is a matter that requires analysis by the technology department, due to cyber security concerns and investment capacity, as many of these applications are priced in dollars.

During the COVID-19 pandemic, the university loaned equipment to students and professors. The emergency remote-learning situation also highlighted certain issues with the LMS used at the time, which was replaced by a different one in early 2022 for use with in-person programs. Nearly all professors participated in online training sessions for the new LMS. The institution mandates that all professors in in-person courses utilize the LMS to provide the course syllabus, grades, and extracurricular activities.

Politically speaking, due to bureaucratic divisions between in-person and online education based on the percentage of workload in each modality, the use of blended learning as a methodology is hindered. Considering the regulatory definitions of online and in-person learning provided by the Ministry of Education, synchronous remote classes, for instance, do not fit into either category. The legislation that sets limits on in-person and online workloads in programs does not allow hybrid learning to be used as a methodology, as it imposes a bureaucratic barrier. In 2022, prompted by changes stemming from the COVID-19 pandemic, the National Council of Education issued Resolution Proposal No 14 on national guidelines for in-person institutional research and learning driven by information and communication technologies [45]. According to that proposal, blended learning could be adopted as a teaching methodology, dismantling the limitations on in-person and online workloads established in previous legislations. If regulated, the content of the Resolution Proposal would represent a significant advancement for the effective implementation of blended learning in Brazil. However, in 2023, with a change in government, discussions were halted, and the Resolution Proposal was not implemented. There still exists a belief in the country that exclusively in-person higher education holds more quality than any online approach, even if hybrid, which puts the Ministry of Education under constant pressure.

5.3. Efforts Moving towards Digital Transformation (PUCPR)

The institution initially intensified its efforts towards digital transformation with the launch of online degree programs, and subsequently, propelled by the need to adapt to live remote teaching during the COVID-19 pandemic. In order to optimize the development and management of online programs, an area in which the institution lacked experience, a partnership was established with an online program management (OPM) provider. However, challenges emerged as the attrition rates in online programs surpassed those of in-person programs. In response, a study was conducted with the aim of identifying the barriers affecting online student engagement and determining how the institution could provide more effective support [23]. The study, conducted through a questionnaire administered to students enrolled in the institution's online programs, focused on three key categories of perceived barriers within the Academic Communities of Engagement (ACE) framework: Course Environment (CE), Learner Characteristics (LC), and Personal Environment (PE) [17,38].

The investigation highlighted that Course Environment (CE) barriers were perceived as the most significant. These barriers encompassed challenges that could be directly addressed through institutional support. Notable CE barriers included limited opportunities for peer collaboration and discussion, text-heavy and overwhelming course materials, inadequate interaction and feedback from instructors, and confusion regarding the learning management system (LMS) and content organization. The study emphasized the importance of enhancing online and blended teaching skills through policies and professional

development to mitigate these CE barriers. Barriers linked to Learner Characteristics (LC) manifested in struggles with time management, work–life balance, and emotional well-being. Within the realm of Personal Environment (PE), challenges emerged from noisy and unsuitable study spaces, inadequate internet connectivity, and suboptimal computing equipment. Fragile family relationships and limited support from friends and employers also hindered engagement. The study sheds light on the tangible challenges confronted by online university students, emphasizing the role of institutions in ameliorating Course Environment barriers and understanding underlying personal and internal factors influencing engagement.

So, the institution started a faculty development program aimed at fostering the creation of more engaging instructional designs centered around key pedagogical constructs such as communities of inquiry, active learning paradigms, and learning outcomes. Moreover, substantial investments were allocated to the development of a novel learning management system (LMS), characterized by streamlined student navigation and the integration of external tools for evaluative exercises, virtual laboratories, simulators, and 3D content delivery. With the aim of reinforcing the pressing need for interaction expressed by students engaged in online program modalities, an ancillary solution entitled "Talk to Us" has been conceived and implemented adjunct to the learning management system (LMS). Through this tool, students are empowered to direct inquiries to course coordinators, academic tutors, or the administrative support team. The aforementioned solution facilitates the monitoring of request flows and response deadlines, constituting a critical operational framework for the management of online student support, a demographic often susceptible to feelings of isolation and disorientation. Approximately 3000 interactions are logged daily within the platform, encompassed within a total cohort of around 7600 online undergraduate students.

Other digital initiatives are currently underway to enhance the integration and sense of belonging of students in one of the institution's online undergraduate programs, called Digital Influence Economics: a virtual campus, and a WhatsApp group mediated by the program coordinator and a community manager. The virtual campus was created on the remote team virtual headquarters Gather (Gather Presence Inc., San Francisco, CA), serving as a collaborative space for students and teachers through their avatars. Figure 5 illustrates a section of the virtual campus, showcasing the university entrance and several gathering tables situated within the garden.

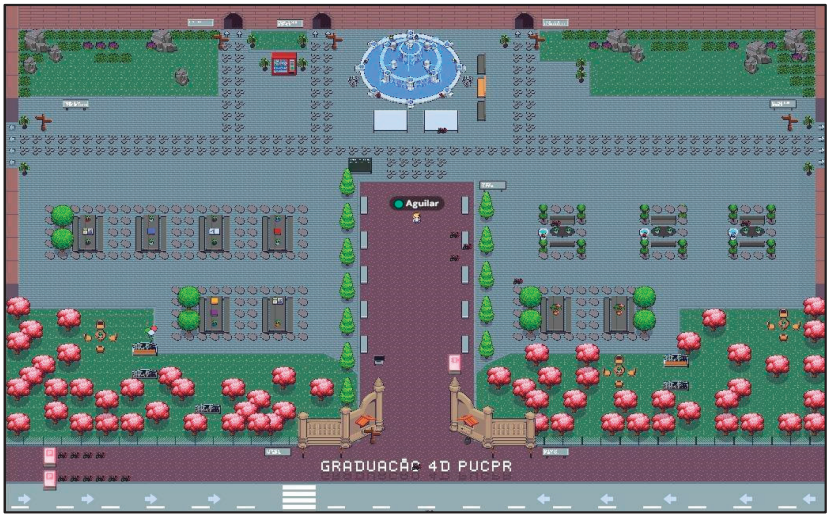

Figure 5. Image of the virtual campus built in Gather.

In this virtual campus, synchronous classes are held, but students can access it at any time of the day to study and converse with teachers and peers, as well as access administrative services, the LMS, course coordination, and the community manager. The community manager encourages the class and reminds them about deadlines and activities using the virtual campus and the WhatsApp group, of which the course coordinator also participates, but not the instructors. The program's coordination noted that students prefer to access the virtual campus during scheduled activities with teachers, such as synchronous classes. During these moments, students feel comfortable interacting orally with their avatars, with the majority of them choosing to activate their cameras during their contributions. It is possible that the personal representation of avatars in the virtual campus environment makes interactions feel more natural, thus encouraging student engagement in discussions. However, the spontaneous use of the virtual campus for individual or collaborative study is still in its early stages, even though communication and group formation in this environment closely resemble natural interactions. The majority of spontaneous interactions occur through the WhatsApp group. Differences in schedules among students could explain the lower rate of spontaneous access to the virtual campus and the significant flow of interactions through the WhatsApp group. Indeed, the use of everyday technologies for students, such as WhatsApp, can make interaction with peers and program administrators in the graduate program more natural through this medium.

Specialization programs are benefiting from the remote live learning gained from the COVID-19 pandemic. The model of synchronous classes existed before the pandemic, but afterward, it became the preferred choice of students and the adopted method for most of the institution's specialization courses. Remote synchronous classes facilitate real-time collaboration between students and teachers, reducing the typical sense of distance in asynchronous online education. Synchronous remote classes were not implemented in the in-person undergraduate programs due to the regulatory gray area mentioned earlier.

Regarding in-person education, a significant institutional digital transformation initiative was the establishment, in 2023, of the Extended Reality Center, a complex with 3000 m^2 of physical space for the implementation of immersive learning experiences to enhance experiential learning. Teachers propose projects that are developed by a multidisciplinary team (programmers, game designers, and educators) to be used with virtual or mixed reality devices or in 360-degree projections.

The perception of gaps in the faculty's capacity for the strategic implementation of educational technologies during the pandemic led the institution to develop a mandatory faculty development project in digital competencies, based on the concepts of the Community of Inquiry [19] and the Padagogy Wheel (the term "Padagogy" combines the terms "Ipad" and "Pedagogy") [46,47]. This project aimed to stimulate teachers' autonomous learning about the use of educational technologies [48]. Until August 2023, a total of 502 professors completed the training, and according to the European Framework for Digital Competence, DigCompEdu [37], they hold the higher levels of digital technologies (leader and pioneer). The main challenges pointed out by the professors were a limited access to free software or the need for paid licenses and the poor quality of the internet on campus. Most of the faculty mentioned that they already used digital educational tools and they could improve the use of them; others mentioned that they prefer hands-on training and tutorials that teach how to use digital applications and tools. The university is currently enhancing the project to provide support and hands-on training to the faculty members who require it.

6. Discussion and Conclusions

The three university narratives described in this paper come from diverse cultures and parts of the world. However, these universities, like many others, are engaged in a process of digital transformation. In all cases, the digital transformation began prior to the global pandemic, but COVID-19 accelerated the urgency of the efforts ostensibly to benefit students, but with obvious additional motives such as student recruitment and economics,

which relate directly to the ability of IHEs to thrive. A few common themes that we draw out of the very different cases include the following:

- The role of local policy in shaping digital transformation;
- The importance of developing human capacity with technology;
- The potential for digital transformation to bring hope.

6.1. Local Policy and Progress

It was clear from all three cases that local policies and politics have a significant impact on IHE efforts towards digital transformation. For example, PUCPR faced a common global challenge with online/distance learning and traditional on-campus learning functions, essentially residing in "two bureaucratic divisions". UNAB also experienced "duplicated efforts and difficulties" as it tried to explore the digital systems needed to support online and in-person learners. MUST also experienced policy challenges as it originally tried to create its own LMS, then began using MS Teams for its synchronous functionality, and ultimately is considering tradeoffs to upgrading their LMS.

Local policies governing online and blended learning have also impacted the ability to engage in the digital transformation of the educational system. For example, educational policies in Brazil that categorize learning as online or in-person based on percentages have created barriers for the exploration of new approaches that mix modalities into hybrid or blended classrooms that seek to take advantage of the strengths of multiple modalities [49,50]. Also, pre-COVID policies in Mongolia helped MUST to already have some momentum in their efforts towards digital transformation, allowing them to become regional leaders and tap into global efforts around UNESCO's Sustainable Development Goal #4 of quality education.

Local policies and governmental rules and regulations are frequently associated with delays in implementing digital transformation [12,51,52]. Lašáková et al. [15] indicated that "too restrictive regulatory practices at the state level, which instill rigid regulations and lengthy decisional processes, considerably limit the implementation of innovations in education". In summation, digital transformation is strongly influenced by local policies and cannot happen effectively without leaders who have an understanding of the policies and know how to navigate and influence their intricacies.

6.2. Technology and Human Capacity

A second theme that came through strongly from the three cases is how essential developing human capacity with technology is to successful digital transformation. Providing a digital infrastructure and selecting the right tools and systems played an important role. But that role is dwarfed by the effort that goes into building instructor and student capacity to teach and learn effectively with digital tools. The International Association of Universities (IAU) conducted two key global higher education surveys, one at the beginning of the pandemic and another a year later. The largest share of IHEs (one out of four) indicated that 25% or less of their teachers were experienced with online or distance teaching and learning [7]. Other authors pointed out barriers to digital transformation related to human capacity [11,12,15]. These barriers can be related to a lack of digital literacy, inadequate information and communication technology (ICT) skills, resistance to change, and risk aversion [12].

All three institutional case narratives talked extensively about their efforts to provide professional development to instructors and staff. MUST and UNAB both developed centers that focus on improving teaching and learning. PUCPR and UNAB also engaged in a systematic inquiry to better understand how students were engaging in digital environments and the barriers and institutional supports that would help them to be more successful [21–23]. They all understand that learners deserve more than just access to learning opportunities; they deserve access to quality learning opportunities, and this is highly dependent on the knowledge and digital teaching skills of the instructors.

6.3. Digital Transformation and Hope

There are many challenges with trying to meet the higher educational needs in a local community. In Mongolia, MUST's efforts sought to expand opportunities to those in many remote locations as well as "innovate and increase the quality of the educational systems". Likewise, in Colombia, underlying efforts centered around improving student engagement and the goal of reducing barriers, particularly for individuals with difficulties in accessing resources or commuting to campus, such as students with a lower socioeconomic status. In Brazil, the digital transformation efforts at PUCPR were focused on improving the student experience by reducing barriers to learning, particularly for those who needed the flexibility of online courses. In all cases, the underlying feeling was that, while there are many challenges with technology in a complex educational ecosystem, if they is implemented with the students' interests in mind, educational technologies can actually bring hope. Individuals have hope that technology can play a role in overcoming persistent challenges such as limited access to or low-quality higher education. Technologies can also introduce barriers to learning, especially if we do not attend to the persistent issues of equity in education [53–55].

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Article

Social Media and Artificial Intelligence: Critical Conversations and Where Do We Go from Here?

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Abstract: Prior to and during the pandemic, social media platforms such as Twitter and Facebook emerged as dynamic online spaces for diverse communities facilitating engagement and learning. The authors of this article have explored the use of social media with a focus on Twitter for engagement and student-centered design of online courses in higher education. As with all technology, social media is also riddled with complex issues and unfortunately, is increasingly considered unsafe. Students have often been hesitant in their use of social media, especially for coursework and unfortunately, this hesitation has only worsened. Considering this and recent developments, social media has become a questionable tool for use in education, yet remains integral to the lives of many, both personally and professionally. The emergence and popularity of generative artificial intelligence (GenAI) tools such as ChatGPT, Lensa AI, and Canva Magic Write present new challenges and opportunities and cannot be avoided by the educational communities. Is there hope for social media and AI tools during these uncertain times? Through the combination of a current literature review and qualitative collaborative autoethnographic research, the authors take a step back and engage in critical conversations about what we have learned from our uses of social media for engagement and learning in our online courses, with a focus on (1) the intentional uses of social media, (2) the challenges and concerning issues of social media tools, and (3) exploring the implications of artificial intelligence. Centering on the theme of "hope," the authors navigate these educational and technological landscapes and answer the question "*where do we go from here?*" The authors are faculty at a southwest border university teaching preservice and in-service teachers alongside those who want to learn more about education and design with learning technologies. Their voices represent faculty, teachers, and students who are engaging with and immediately impacted by the challenges and opportunities of rapidly advancing technologies.

Keywords: online education; critical conversations; social media; Twitter; artificial intelligence; ChatGPT

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1. Introduction

In the early 2020s, a series of pivotal events, for better or worse, have significantly reshaped the educational technology landscape. These included the global COVID-19 pandemic and subsequent lockdowns, which fundamentally impacted how education is delivered and experienced, the upheaval in the social media landscape, and the release of generative artificial intelligence (GenAI) tools like Chat Generative Pre-trained Transformer (ChatGPT). There are many critical questions to ask and conversations to be had about uses of the Internet, everything on the spectrum from the concerns and problems of mental, physical, and digital health/safety which have been increasingly in the spotlight, to the implications of empowerment and engagement for teaching and learning. In higher education, it is too soon to fully understand the full impact of the pandemic; however, things seem to have settled a bit in a simultaneously concerning yet hopeful aftermath. It

is a concerning time due to disruptions, failures and dehumanization in education due to the pandemic [1,2], as well as increased uncertainty and instability evidenced in existing and new technologies [3]; yet, it is hopeful because we are humans, and as we can, we will strive to take the next best steps for our students and for each other.

In this article, we explore our journey as educators and collaborative autoethnographers under a guiding pedagogy of love, care, and hope [4–7]. We will share our ongoing learning experience with each other and with our students. In facing new challenges and in the evolving landscape of social media and technology, we have adapted our teaching methods over time, shifting from a tool-centric approach to one that is student-centered and humanizes online learning. This shift is exemplified in our transition from viewing social media tools such as Twitter as technological tools and teaching from the how-to tutorial approach to recognizing their potential and affordances for empowerment and increasing engagement, such as design and teaching to align with the Community of Inquiry (COI) framework for both formal and informal learning [8].

With the juxtaposition of challenges and issues in using social media for learning and the rapidly rising popularity of GenAI tools like ChatGPT, we recognize the imperative to cultivate critical conversations in our teaching practices. As educators, and in particular educators in the fields of learning design and STEM, we have a responsibility to participate in guiding our learning communities through these new technological landscapes thoughtfully. We posit that answering the question "*where do we go from here?*" is absolutely a hopeful endeavor and prioritizes humanizing educational experiences, in this case, online educational experiences.

2. Methods and Context

We, the two authors of this article, are drawn to writing together due to our aligned interests in creating optimal learning experiences for our students, especially in online learning environments. We teach primarily online courses for educational technology and STEM programs in higher education. We teach both undergraduate (primarily preservice teachers) and graduate students. Our graduate students include teachers, faculty, and others with goals to become teachers or instructional designers. We meet consistently mostly via web conferencing through Zoom but also in person as we can. We use our archived online courses to engage in critical conversations, wherein we share our experiences and analyze what is and is not working from individual perspectives as well as the shared comparative experience. We review the current literature and participate in our own networks including LinkedIn, Facebook, X (formerly known as Twitter), and TikTok, and share with each other what we are encountering and learning. We started recording our conversations in the web conferencing tool Zoom, as this creates transcripts that serve as a form of reference and data collection.

In our work with additional colleagues, we identified that the best way to describe our research work is from the qualitative social science research perspective and the use of collaborative autoethnography (CAE) methods [9]. Collaborative research performed in groups and duos is quite common, but this model is unique, as rather than researching externally, "collaborative autoethnographers turn their interrogative tools on themselves, generating and utilizing their autobiographical data to understand social phenomena" [9] (p. 37). CAE "preserves the unique strengths of self-reflexivity associated with autobiography, cultural interpretation associated with ethnography, and multi-subjectivity associated with collaboration" [9] (p. 17). This approach "challenges the hegemony of objectivity or the artificial distancing of self from one's research subjects" [9] (p. 18), and the benefits of CAE include "power sharing, learning from one another, and efficiency in engaging in qualitative date collaboration" (p. 12).

When it is the two of us, our CAE approach is duoethnography: "a full dialogue model between two researchers," as discussed by Chang et al. [9] (p. 50) and is also referred to in this article as "critical conversations." In addition to our continuous, asynchronous (e.g., email, Google docs, and social media messaging), and synchronous dialogue

(e.g., Zoom, phone, and in-person meetings), we agree with identified core tenets of duoethnography, including the need to recognize differences and power differentials in support of establishing a baseline as equal collaborators and "the importance of noting the situatedness of meaning" [9] (p. 51). As we develop our manuscripts, we work both concurrently and sequentially, using Zoom and Google Docs to converse and brainstorm, write, and rewrite. This is both a challenging yet highly rewarding process, with personal outcomes that are greater than the writing and critical for our own course design and students, as we navigate the protean, opaque, and unstable digital landscape [3].

For several years, part of our ongoing dialogue and research has been focused on the use of social media, especially Twitter, for increasing interactions and presences, and thus, engagement, community development, and learning in our online courses. We currently teach online using the learning management system Canvas, and the web conferencing tool Zoom. Though the use of Twitter has been one of our key research foci, we have also used Facebook, TikTok, and Instagram. However, in 2022, Twitter was sold, renamed to X, and is continuously being radically modified, making it difficult to use with students and for the first time in years, in the fall of 2023, one of the authors did not include the use of social media in her online courses. As we were discussing these issues and this article early in 2023, GenAI technologies entered the digital landscape. These tools, especially ChatGPT, created a deep stir in education and became a part of our conversations. Thus, the purpose of this study is to explore the overarching question "*where do we go from here?*" as related to the use of social media and artificial intelligence in our courses and with our students.

3. Conversations with Current Literature

The call for this special issue provided a timely and relevant catalyst and backdrop to engage in critical conversations and address the disruptions and developments in social media, as well as the advent of new GenAI tools and what they mean for teaching and learning in our own online courses set for higher education. We engaged with the current scholarly and grey literature as part of our critical conversations and addressed our focus areas for this article, including what we have learned about the intentional uses of social media, the challenges and concerning statuses of social media tools, and the implications of artificial intelligence.

3.1. Intentional Uses of Social Media

Social media was not originally designed for educational purposes, but certain features such as Web 2.0 applications and social networking have made it a useful tool in education [10]. Twitter as a microblogging tool that includes the engaging and organizational feature of hashtags, supported professional [11] and self-directed learning [12], and has an impact on the community, communication, and casual (informal) learning for students [13]. Social media creates connections for niche communities and is often described in the context of the development of personal and/or professional learning networks (PLN) [14,15], creating broader individual and collective learning opportunities. Professional educational communities have found numerous types of interaction, engagement, and empowerment [16], and consider the criticality of Black Twitter [17], wherein exists "one of the largest gatherings of Black online users ever" and "serves as a potent example of Black digital expertise" (para 3); and some are asking, "What's going to happen to Black Twitter?" (para 2).

The literature on social media and education highlighted that the use of social media platforms such as wikis [18], Twitter [19,20], and/or Facebook [21] resulted in higher participation and improved learning in secondary and higher education [22]. In our own recent research, we looked at social media and Twitter use in our online courses. In one study, we identified "(1) evidence of cognitive, social, and teaching presence for students completing course activities using Twitter, that is, for their formal learning; and that (2) students developed course competencies during formal course activities using Twitter that supported cognitive and social presence beyond the course requirements,

that is, for their informal learning" [8] (p. 327). In a follow-up study, we identified the importance of engaging students with "(1) sharing of learning artifacts, (2) engaging in creative pedagogical practice, (3) the concept of fun, and (4) collaboration and teamwork", which confirmed for us "(1) the importance of student-centered design, (2) the continued use and adoption of relevant technology tools and skills, and (3) building community with the frameworks of Community of Inquiry and the modes of interaction model" [23] (p. 251). This successful use of Twitter encouraged us to continue revising our courses, focusing on student engagement as a priority during and immediately after the pandemic, when the challenges for online learning were amplified. However, in 2022, we were in dialogue about our teaching and students and started discussing the issues we were experiencing with our uses of social media.

3.2. The Challenges and Concerning Status of Social Media

Until recently, the perceived benefits of integrating social media into education outweighed its disadvantages [24,25] prompting many educators, like us, to adopt it as a tool for facilitating engaged learning [26]. Of course, using social media in education has had its issues. Challenges have included classroom distractions [27], a perceived loss of control over students in the classroom [28], and reduced student focus and multitasking negatively impacting learning, performance, and retention [29]. Additionally, concerns have arisen among students who are not comfortable using social media due to concerns of social media addiction and cyberbullying [30–33], issues related to security and privacy such as the public accessibility of information [34], and an inundation of misinformation and disinformation [35].

Sundaram and Radha [36] investigated the security involved in social media use among youth internet users. They found that social networks store end users' information remotely to personalize services and sell information to advertisers. These practices raise concerns about privacy and the commodification of personal information and contribute to the accumulation of "Big Data" [36]. Big data has been identified both as a priority and concern since 2014–2016 by the policy of the Obama White House Office of Science and Technology [37]. Moreover, this use of automated and algorithmic processes in social media has led to concerns about unintended bias and discrimination [38,39], which can be perpetuated through academic texts [40,41] and news outlets [42]. Bias in machine learning has been discussed by researchers [43,44], and experts argue that these technologies are not neutral; rather, they are value laden [45–47] and their design has the potential for "racialized, gendered and colonized hierarchies" [37] (pp. 2123–2124). These issues have become increasingly present in recent years, particularly with significant events such as the COVID-19 pandemic, the sale of Twitter, and the rise of GenAI tools. Author B encountered increased concerns about the use of social media from students in an undergraduate course in 2022 and author A was experiencing increasing challenges using Twitter in her classes; both authors have felt the need to step back and hold critical conversations with each other and their students. As humans and educators, it is incumbent upon us to take responsibility and be accountable for the outcomes we are all experiencing. With increasing challenges and concerns in the social media landscape, educators and educational researchers are taking a step back, and with the advent of generative AI tools that carry many of the same issues alongside new challenges, Mishra et al. note both "hand-wringing-and some celebration-about the impact these tools will have on education" [3] (p. 235).

3.3. The Implications of Artificial Intelligence

Artificial intelligence in education has been the subject of research for over two decades [48]. However, it was not until the past couple of years (2022–2023) that AI tools, specifically generative AI tools like ChatGPT, DALL-E, MidJourney, Bard, Bing Chat, Lensa AI, and Canva Magic Write [3,49,50], became widely accessible and started to influence online teaching practices. ChatGPT was released by OpenAI to the world in the late fall of 2022, and at the time, it was estimated to have reached "100 million monthly active

users in January 2023" [51] and was noted to be "the fastest-growing consumer application in history" (p. 1). Watters and Lemanski [52] conducted a review of the early literature on ChatGPT, with findings revealing a "predominance of negative sentiment across disciplines" and "raising concerns about employment opportunities and ethical considerations" similar to concerns of use of social media and the internet in general of "privacy, bias, transparency, and accountability", yet holding "promise for improved communication" and needing further research "to address its capabilities and limitations" (Abstract and Discussion para 2). Dai, Liu, and Lim [53] identify ChatGPT as "a student-driven innovation" (p. 1) and a "potent enabler for enhancing education quality and transforming higher education" specifically, as it and tools like it "can be leveraged to enhance learning analytic techniques, generate customized scaffoldings, facilitate idea formation, and eventually expand educational access and resources for social justice" (p. 2).

Sok and Heng [54] highlighted some time-saving educational uses of ChatGPT, including helping teachers develop learning assessments, provide virtual tutoring, draft outlines, and brainstorming. They identified concerns related to such uses of ChatGPT, especially in regards to academic integrity including biased learning assessments, inaccurate or fake information, and an overreliance on AI tools. For example, using AI for brainstorming an idea or to create an outline could interfere with students developing these skills as well as losing the practical experience of becoming successful after struggle [55]. Part of the art of teaching and learning is scaffolding student learning and balancing it with the right amount of struggle, i.e., through the zone of proximal development [56]. If artfully used, these burgeoning GenAI tools might support scaffolding and assistance to the struggling learner, creating the opportunity for learning at the early stages where a student might give up, thereby facilitating and deepening learning experiences, e.g., "get away from the high school paper and go further, to write something larger, like a thesis" [55] (para 33).

The impact of GenAI on educational practices is in its early stages, and it is ChatGPT that is generating most of the discussion. The discussions cross the spectrum from the language of opportunity, time-saving strategies and efficiencies, hopeful transformations, and the potential to revolutionize education [57–59] to the language of challenges and fears; again, mostly regarding how assessments will be impacted and long-held concerns related to cheating and plagiarism [58], but also vulnerabilities related to bias, dis- and misinformation, and cybersecurity and privacy [52,60,61]. Fullan, Azorín, and Harris [58] note that "an assessment of the real impact that this technology will have on teaching and learning for good or bad, has yet to be made," that "there is a lack of research, guidelines, and regulations specific to ethical issues raised by the application of GenAI to education," (p. 2) and that there is a tangible fear regarding "whether AI in education has been designed to supplant teachers/leaders or reduce them to a functional role, rather than to assist them to teach/lead more effectively" (p. 5).

Of note, two key publications have been especially instrumental as we engaged in dialogue and critical conversations. The first, "TPACK in the age of ChatGPT and Generative AI" [3] was a product of interinstitutional coauthoring by one of our colleagues within our department who shared it with us. In this article, Mishra et al. [3] highlighted the need to further develop "TPACK in the age of Gen AI," (p. 247) arguing for a "more expansive description of contextual knowledge (XK)" (p. 236) that accounts for the broader implications of GenAI on individuals and society. This work provided key essential descriptions and terminology, including a description of GenAI as "applications which are designed to create new content (text, images, video, music, artwork, synthetic data, etc.)" (p. 236). Additionally, they offered a set of probing questions that enriched our critical conversations. They note that these questions should have been "asked of social media over a decade ago" (p. 237) and we agree, as we step back from our own uses of social media. The first questions in their list are "What does it mean to teach in an era where GenAI becomes part of our everyday life? In a time when it will be increasingly difficult to distinguish between AI-generated and human-generated content?" (p. 237).

The second publication, "How do we respond to generative AI in education?" by Mills, Bali, and Eaton [62], proposes that open educational practices "can help educators cope and perhaps thrive in an era of rapidly evolving AI" (p. 16). It was shared with one of us on LinkedIn and begins to address the aforementioned questions by advocating for open educational practices, two of which stood out for their immediate relevance to this study: engaging with interdisciplinary and interinstitutional online communities for ideas exchange and reflection and collaborating with students. These practices are not just theoretical, as they are the very means by which these articles reached us, exemplifying the power of open educational resources. Furthermore, the practice of collaborating with students has been crucial for us in answering the question "*where do we go from here?*" In Section 4, author A provides an autoethnographic narrative reflecting and responding to this question.

4. Where Do We Go from Here? Narrative Reflection and Response

Dede and Lidwell [63] note that "AI is becoming increasingly proficient at calculation, computation, and prediction ("reckoning") skills" and forecast that "we will see increased demand for human judgment skills such as decision making under conditions of uncertainty, deliberation, ethics, and practical knowing." They challenge us "not merely to understand how remote learning and AI can scale present capabilities, but to also use this moment to reflect and reimagine the learning experiences of students" (p. 7). Author A engaged with the current literature and reflected on her experiences this year, 2023, with online teaching and learning in her classes and with her students.

4.1. If the Robots Take Over, Shame on Us!

I joined Twitter in 2006 and have been formally using Twitter in my courses since 2011 when I created an activity: the Twitter Top 5, which combined developing collaborative teamwork skills and developing personal learning networks (PLNs) alongside the exploration of Twitter. With my classes (I teach in fully online programs), we would create what we would refer to as a "community bubble of safety", and in addition to the Twitter Top 5, students shared their learning artifacts and their creations such as infographics, concept maps, comic strips, etc., and synthesized reflections based on their "aha!" discovery moments in class; they engaged in fun meme wars and the use of hashtags for interaction and networking. I think it is also important for me as an educator to enjoy the process of teaching and learning, and engaging with my students on Twitter did that for me as well. Of note, there was one semester that I tried TikTok instead of Twitter, and it just wasn't the same community building experience, as it lacked the ease of use that Twitter provided.

Upon examining our courses and reviewing the effectiveness of our social media strategies, particularly in our use of Twitter as highlighted in Section 3.1, I found it affirming to identify the successful aspects of these practices. Twitter has served as an exemplary platform for teaching social media dynamics, and only by helping others use this tool was I able to explain to others why it was continuously highly ranked and was the #1 top ranked tool for seven years (2009–2015) on the Top 100 Tools for Learning [64] list that I have been tracking since 2007. Twitter remained in the top 20 until this year, 2023, when it dropped to number 22. There was another tool that upon release, immediately entered the 2023 Top 100 Tools for Learning [64] list at number 4: ChatGPT. By spring 2023, when ChatGPT was introduced, I was having numerous conversations with colleagues and students about what was happening in social media. There were senate hearings about TikTok and the potential banning of TikTok, and as Twitter was sold and renamed X (I call it TwiX), the social media experience for student learning was quickly deteriorating.

For example, in my summer class, my posts and my students' posts would intermittently not publish, and with constant changes within the platform, its instability tipped the scales in disfavor of use, and I was literally pondering this question of "*Where do we go from here?*" In the summer of 2023, with the articles from Mishra et al. and Mills et al. in hand, I engaged my online social media in education class in a transformative process. We

collectively examined the role of social media and technology in our lives and academic endeavors. Through participatory design during our live class meetings, we co-designed new class activities and projects. These included developing personal social media and tech health plans, implementing individual pathways of learning to explore artificial intelligence, and creating team presentations on the topic of a digital bill of rights. Additionally, we discussed our developing ideas about the values and norms we should be thinking about regarding student use of artificial intelligence tools in our programs and courses, and started the Building on Class AI Values and Norms document (see Appendix A) that I now use with all of my classes.

And so, for the first time since 2011, in the fall of 2023, I chose not to incorporate social media platforms into my teaching. What I have done is keep and expand upon the many things I have learned from using social media, with a focus on humanizing online learning [65] and the use of student-centered design models. I also continued to employ participatory design [66,67] and cocreation [67,68], and prioritize critical conversations. Engaging in critical conversations can mean conversations that are important and timely in topic and/or it can mean critical in process. In either case, they require scaffolding, and I do this with the use of community-building strategies to foster a safe and trusting space. While the COI framework remains a foundational model in my approach, I also introduce my students to the concept of an innovative knowledge-building community [69] as a comprehensive framework for these critical humanizing strategies.

Moreover, the shift away from social media has allowed for the greater exploration of emerging technologies like virtual reality (VR) and AI, which have captured the interests of students, particularly when they have the autonomy to choose their topics. For example, in my first 8-week, online, fall 2023 class, where students formed two teams to design, develop, and deliver webinars, both teams chose to focus on AI in education. It is important to note, that as the learning designer, my own focus on these tools is influential on my students' choices, and students from the summer class were in this fall class. In this class, our formal interaction with AI was focused on my redesigned syllabus and an orientation webinar where we discussed class AI values and norms.

I keep an open discussion for students to ask me any questions they have, and I had shared that I was working on this article, and one student asked me to share my thoughts at the time about AI and social media. This was my response:

"Hmmm, as you probably already know, AI caught all of our attention. So, integrating that in the social media course and webinars courses and seeing everyone take off with it, was so great! I do think the VR/AR tools are going to be something to watch for though the expense is an issue as is true with a lot of digital scenarios. The collaboration between Meta and Ray Ban AR might be interesting.

By adding Twitter in the past, that one thing gave us some fun interaction and I loved it. Now I have to rethink my social media scenario as Twitter implodes. TikTok was fun too but there's something too much with TikTok that I'm also unsure about. So, I am falling back on individualization/personalization strategies that I see students learn so much from. I am referring to the 1.6–4.6 activities in this course. It might not be as fun, but I see the engagement.

So, I mostly think our theoretical and conceptual frameworks that drive our strategies for engagement are what are most important. I'm still working on this but I would say that my theoretical framework includes the Pedagogy of Love, Care, and Hope and my conceptual framework include a blended focus on Universal Design for Learning (UDL), and TPACK along with the presence and interaction models. Under those frameworks I would note powerful strategies for engagement such as gameful design, community building, collaboration, teamwork, synchronous interaction, reflection, etc. We can really do a lot with the basics of Canvas, Zoom, and Google Docs with these strategies. Also, I have worked with my students through participatory design a lot over the years to make discussions and activities more engaging" [70].

I have adopted and shared with my students the phrase "If the robots take over, shame on us! For we did not do enough to humanize education." This has helped us to create a focus in our class conversations on what we hope remains key to designing optimal learning experiences: the humans.

4.2. Modeling and Disclosure of Use of ChatGPT

In my classes this year, I modeled and discussed my use of ChatGPT, and as noted in Appendix A: Building on Class AI Values and Norms, we all agreed on the importance of transparency and disclosure when we use GenAI tools, as well as citing when we reference ChatGPT. Here is our disclosure of use in this article, and the quote below from ChatGPT is added to our references.

I use the ChatGPT Plus plan. As we wrote this article, I asked it for three types of help. First, sometimes I wanted ideas to reword something that I was trying to say. For example, for the first sentence of the Introduction, I wrote, "In the early 2020s, several things occurred that, for better or worse, have completely altered the educational technology landscape including" and I asked ChatGPT for a different wording, and it gave me "In the early 2020s, a series of pivotal events, for better or worse, have significantly reshaped the educational technology landscape." Second, I asked it to provide an editorial review of our literature review, and we updated it with a few of the recommendations. For example, in the Implications for Artificial Intelligence section, we started with only the two key publications, and ChatGPT recommended "Discussing the implications of AI in education in more depth, including both opportunities and challenges, would enrich the narrative" [71]. And third, we normally work in APA, and rebuilding the References section was tedious. So, I gave ChatGPT the references numbered 30–74 to help format it. It provided most of the formatting, and then we went through bolding the journal years, checking the abbreviations of some of the journal names, and adding the locations and dates of the conference proceedings publications.

5. Discussion

Facing the dynamic nature of educational technology, our goal as educators is to strategically shift and adapt, remove barriers, address critical needs, and foster robust support systems for our students that can advance education in ways that positively impact employment and job satisfaction. As we navigate the evolving landscape of technology in our personal and professional spheres, we remain committed to exploring innovative ways to integrate social media and AI into meaningful learning experiences, most of which, in our cases, are online. Our journey has shown us the benefits of social media in enhancing student interaction, fostering COI, and developing personal learning networks [7,8,23], thereby increasing engagement and supporting student learning.

We envision a future where our understanding of technology's transformative potential is matched by our ability to apply it effectively in communication, education, and problem solving. Central to harnessing this power is the emphasis on collaboration and community building through critical conversations. Our focus is not merely on whether to use specific tools, but on empowering learners, educators, practitioners, and researchers to utilize these tools effectively. We strive to go beyond mere interface adjustments, prioritizing practices that humanize the educational process by openly addressing issues, fostering community, and designing interactive activities and assessments. This approach will help mitigate ethical concerns, support academic integrity, and enable us to achieve our educational aspirations.

Our approach to teaching and learning with technology is balanced with a critical awareness of safety and mental health considerations. We continuously reflect, engage in research, and implement participatory course design, embodying the pedagogy of love, care, and hope. Even as we may step away from certain tools, we continue to explore new ways to engage the students utilizing our pedagogies, strategies, and tools relevant for the times. These tools might be tried and true like institutional learning management

systems, or they might be emergent like VR and AI that require our engagement to support our communities. In regard to ChatGPT and other similar tools, simply prohibiting AI use is not a solution. Instead, we encourage collaborative exploration with students to discover strategies for learning with AI, leveraging its strengths for tasks like summarizing, editing, brainstorming, and receiving feedback. One essential skill has arisen, prompt engineering, where one can achieve a vast array of tasks and engage in a productive communicative interaction with these tools. Designing courses that involve students in ways that go beyond AI's capabilities, discuss objectives of assignments which require individual learners' perspectives, and clarify academic integrity and the ways to adhere to it will create value when designing, teaching, and learning with technology.

We recognize the success of our teaching through student participation and their engagement in our courses, their participation in and cocreation of a vibrant knowledge-building community, providing tools such as Twitter and ChatGPT and resources such as OERs that are creatively utilized by students, and we revise our primarily online courses based on student feedback. Students cocreate class activities and complete the activities, and students are producers in our classes. We design classes in a way for students to be successful, learn educational theory alongside instructional design, and we provide a statement in the syllabi that grades are conceptualized as progress updates similar to gameplay, and our primary goal is to excite students about the work and make learning contextual and meaningful. The context involves students from beginning to end becoming part of the design, completing the task of creating activities, analyzing, and reflecting.

A recent example of the power of these strategies is a project in one of our classes that is focused solely on online teaching and learning. Students were put in teams of 4–5, and each team was assigned to create a microlearning online course to include a document of standard operating procedures. This was a daunting task for an 8-week course, but they were provided appropriate content, scaffolding, resources, and instructor coaching. The use of GenAI was addressed at the beginning of the course (see Appendix A). The use of GenAI was discussed as questions arose and was indicated in SOPs and courses as relevant. Each team was successful with these tasks, and at the end, proudly presented outstanding final products (SOPs and fully developed microlearning courses) in our end-of-course live class meeting in Zoom.

6. Vision for the Future of Online Education with Social Media and AI Technologies

As we envision the future of online education with social media and AI technologies, we recommend and advocate for a widespread digital and media literacy education, enhanced cybersecurity training, in-depth discussions on core issues, and the development of effective usage policies. Professional development for educators on integrating these tools into the classroom is crucial. We encourage teaching students to use these tools responsibly, adhering to ethical standards. Tailoring the codes of conduct to course levels is important, as the applicability of tools can vary. Emphasizing the proper citation and disclosure of AI assistance is essential. We also recommend designing assignments that require not only writing but critical thinking, thus, promoting learning even with technological assistance. Grading criteria should focus on aspects challenging for AI to replicate, such as originality, emotional depth, metacognition, and personal experiences [55]. Finally, transparent institutional policies should be established, allowing for research and experimentation.

Finally, our answer to "*where do we go from here?*" includes a vision for the future of online education, where pedagogy is deeply intertwined with practice and is focused on approaches that prioritize humans and humanizing teaching and learning. Under an overarching pedagogy of love, care, and hope, our practice is rooted in the principles of participatory design and cocreation of collaborative and individualized learning experiences, where learners are active contributors to their educational journeys. We advocate for design practices that embrace the Universal Design for Learning (UDL), which promotes multiple forms of engagement, representation, and action/expression [72], along with fostering online learning communities as modeled by the COI framework [8,73] and innovative

knowledge building communities [69]. In these online learning communities, students feel safe and empowered, and in a state of innovation and cocreation, they can and will collaborate with us to continuously help re-envision and redesign education.

While pedagogy and design are at the forefront, purposeful selection and use of technology is essential. Hope is not found within the tools, but within the humans who wield them and who make the critical educational choices. In this case, we chose to step back from social media tools that we had learned to step up engagement with, primarily Twitter and Facebook, and leveraged established technologies like our learning management system, Canvas with its integrated Canvas Studio, and the web conferencing system Zoom. Additionally, we incorporated tools for student creation like Canva, as well as explored the potential of newer technologies, such as ReadyPlayerMe in preparation for virtual reality and GenAI tools like ChatGPT to engage learners. TwiX is still there, in the background, under discussion, and maybe we will use it again in the future, or maybe not. What we will do is focus on the humans and on the relationships, and never let the robots take over! If the robots take over, shame on us! For we did not do enough to humanize education.

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Data Availability Statement: This is a collaborative autoethnography and the data is primarily the voices of the authors shared within this document. The relevant online course data is provided in the Appendix A.

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Appendix A

Building on Class AI Values and Norms

- Values: integrity, responsibility, accountability, ethics, critical thinking
- AI is useful as a tool and an affordance, like we see with the Internet itself and tools like Google, Google Scholar, etc. We are encouraged to try/explore/experiment with new concepts and technologies, and in this case, we focus on artificial intelligence (AI).
- We will keep each other informed about exciting, interesting, scary/concerning, etc. things we encounter and encourage each other in this process.
- If we don't know something, we will just ask. Not only the professor but each other (there will always be space and time for this).
- AI should be recognized as riddled with issues, inaccuracies, incompleteness, biases, etc. We must explore and identify these issues. For example, you will hear Dr. Parra say, "Chat GPT is actually a liar!" and is noted in the research as being "notorious for generating text with 'hallucinations" [74].
- We must remain vigilant and mindful of relevant issues and ethics. Note that we must use these technologies ourselves to be knowledgeable and lead the way. We will be respectful, continually investigate the relevant ethics, and work within ethical uses to the best of our ability.
- There can be a thin line when it comes to AI and plagiarism similar to the use of research journals, online resources, etc. AI should not be used to do the work for you. Use AI as a tool and do not copy/use it verbatim. Be transparent.
- Disclose when AI is used. Use APA in our program to cite your AI use.
- Cross reference any images used/provided for potential copyright issues, and as relevant, provide any relevant citations.

- Apply digital citizenship and literacy knowledge. Use critical thinking. Stop and question for all of the above.

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Article

Future Potentials for International Virtual Exchange in Higher Education Post COVID-19: A Scoping Review

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Abstract: (1) Background: International virtual exchanges (IVEs) are here to stay. The coronavirus pandemic of 2019 (COVID-19) necessitated global virtual interactions to solve wicked problems. Within industry during the pandemic, the use of online technologies expanded at a never-before-seen rate to form global partnerships At the same time, higher-education institutions lessened traditional international offerings, reimagining "campus" education using "just in time online education". Still others leveraged international partnerships to fully embrace IVEs. Adopting virtual learning technologies to support global exchange in this way develops the knowledge and skills required in a post-pandemic world. To continue to shape knowledge that supports international collaboration toward addressing increasingly complex societal issues, higher education must learn to leverage IVEs, addressing issues of access, equity, and cost. (2) Methods: This research was conducted according to the "Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews" (PRISMA-Scr) guidelines. It systematically analyzed the literature published since the start of the COVID-19 pandemic, exploring methods, models, and the outcomes of IVE in higher education. (3) Results: The findings demonstrate the potential for IVE to be scaled across higher education to promote the knowledge and skills required by a global ecology.

Keywords: virtual exchange; scoping review; online learning; higher education; internationalization; intercultural education

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1. Introduction

International virtual exchanges (IVEs) are here to stay. The coronavirus pandemic of 2019 (COVID-19) necessitated IVEs to solve wicked problems. As O'Dowd [1] notes, within industry during the pandemic, the use of online technologies expanded at a never-before-seen rate to form global partnerships. Yet, at the same time, institutions of higher education lessened traditional international offerings, refocusing on how to reimagine "campus" education with "just in time online education". Still others leveraged international partnerships to fully embrace IVE.

Since the 1990s, higher-education institutions have been leveraging virtual or online learning to promote IVE between geographically distanced students and instructors, particularly in relation to online intercultural education aimed toward "linguistic accuracy, intercultural awareness, intercultural skills and electronic literacies" [2] p. ix. More recently, this pedagogical approach by scholars in the field to promote cross-disciplinary collaboration on effective implementation within universities has been termed virtual exchange [1]. Thus, IVE relates to leveraging virtual technologies to bring together internationally distributed classes to engage in academic collaboration and cooperation for reciprocal benefits [2]. The benefits of IVE, particularly in relation to language learning,

were noted well before the COVID-19 pandemic, including promoting language learning and global citizenship, preparing students for an increasingly international and global focused workforce, and facilitating access to diverse cultures and geographies for learners who might not otherwise have access to the physical or financial means needed for these types of interactions [1,3].

COVID-19 necessitated the adoption of virtual collaboration on an unprecedented scale across industries (e.g., healthcare, business, and politics), with many advances in technologies, policies, and processes to achieve a level of collaboration and cooperation previously achieved in face-to-face settings. Similarly, academic institutions adopted "just in time" IVEs to augment the loss of traditional international exchange programs and potentially allow students to still benefit from these types of global learning opportunities. However, it is important to recognize IVE as an essential tool within higher education requiring more than the "just in time" adoption of online education platforms or virtual technologies to provide a "space" for interaction across geographical distances. It is also important to recognize its potential to extend beyond the context of language learning to develop the requisite knowledge and skills for global interactions in other fields. So, we must evolve beyond "just in time" IVE to planned, pedagogically sound online programming that develops the knowledge and skills students require to engage in cross-cultural collaboration and cooperation toward solving wicked global problems. Challenges to recognizing this vision in higher education relate to the "notable shortcomings in virtual exchange research and practice" [3] p. 401.

To continue to shape knowledge that supports international collaboration toward addressing increasingly complex societal issues, higher education must learn to leverage IVE while addressing issues of access, equity, and cost. This scoping review queries the literature published since the start of the COVID-19 pandemic to explore how IVE has been operationalized or modified in higher education in response to COVID-19 and potential outcomes. To address this overarching goal, articles were analyzed to consider the following sub-questions:

- How does the literature consider the potential of IVE to address challenges related to the digital divide and equitable access to the use of technology?
- How does the literature represent the application of IVE to facilitate intercultural awareness?
- How does the literature consider the potential of IVE to promote higher-order collaborative engagement and thinking?

2. Materials and Methods

The purpose of a scoping review, as [4] describe, is to identify types of evidence, clarify key definitions and concepts, examine how research is conducted, identify key characteristics, and identify knowledge gaps in a specific topic or within a certain field. We adopted [5] as our methodological framework to conduct this scoping review. This approach details a five-stage process: (1) identify the research question, (2) identify relevant studies, (3) select studies and extract data, (4) chart the data, and (5) collate, summarize, and report the results [5]. We were also guided by the "Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews" (PRISMA-Scr) [6]. The description of the methods below aligns the stages indicated by [5] while including the requisite items in the PRISMA-Scr.

2.1. The Scoping Review Question

Given our interest in describing the application of IVE in higher education post COVID-19, the following question guided this review: what is known in the existing published literature about the application or modification of IVE models within higher education and their related outcomes since COVID-19 (March 2020)?

2.2. Identifying Relevant Studies

We conducted a scoping review using keywords and free-text terms related to IVE and higher education. Search string terms included "Global virtual exchange" or "virtual exchange" or "COIL" or "global classrooms" or "transnational virtual exchange" or "international virtual exchange" or "telecollaboration" and "Higher education" or "university" or "college" or "tertiary education" or "post-secondary education".

We searched in three databases relevant to higher-education research including EBSCO Host, the Education Resource Information Center (ERIC), and Google Scholar. The searches were limited to open-access, peer-reviewed articles published in English from March 2020 to the time of the search (August 2023). Table 1 details the results of the finalized search string for each database and the number of articles identified using these inclusion criteria. It is worth noting that the initial results were influenced by the differing ways that the search string term "COIL" was applied across disciplines, which yielded articles in fields outside of higher education.

Table 1. Search results by database.

Database	Articles Relating to Initial Search String	Duplicate Articles with Other Databases
EBSCOHOST	111	0
ERIC	178	0
Google Scholar	15	0
Total Articles for Title and Abstract	304	

2.3. Selecting Studies and Extracting Data

The initial search yielded 304 results, with no duplicates between databases. In our screening process, publications were excluded if they were (1) not open access, (2) not published in English, (3) not peer-reviewed, (4) not on the subject of IVE, (5) not directed related to a higher-education setting, or (6) did not address new or expanded applications of IVE due to COVID-19. Our criteria to only include open-access, peer-reviewed work was guided by [7] recommendation on open educational resources, which affirms the right of all people "to seek, receive and impart information and ideas through any media and regardless of frontiers, as well as the right to education (Article 26)", in the Universal Declaration of Human Rights. As an emerging medium and given inequities that currently exist in international education broadly, access to resources is necessary for more equitable awareness of IVE and effective practices for program development and implementations. While refining the search beyond publications utilizing English as a lingua franca would further these aims of equity, this was beyond the capacity of the current research team. Our hope is that this scoping review will connect with future discussions of IVE that extend these aims.

For title and abstract screening, each article was reviewed by two of three researchers (G.L., G.W., and P.M.) for inclusion or exclusion based on the criteria set. Disagreements were decided by the third researcher, who did not review the given article. During the title and abstract screenings, 222 results were excluded. Prior to a full-text review, we excluded 25 additional articles due to open-access issues in gathering the full text for consideration. Therefore, the full-text screening process involved 57 articles. The same process for screening was applied for a full-text review between G.L., P.M., and T.W. During the full-text review, 36 articles were excluded, yielding 21 articles available for data extraction and charting. Figure 1 presents the search decision flowchart during the review process.

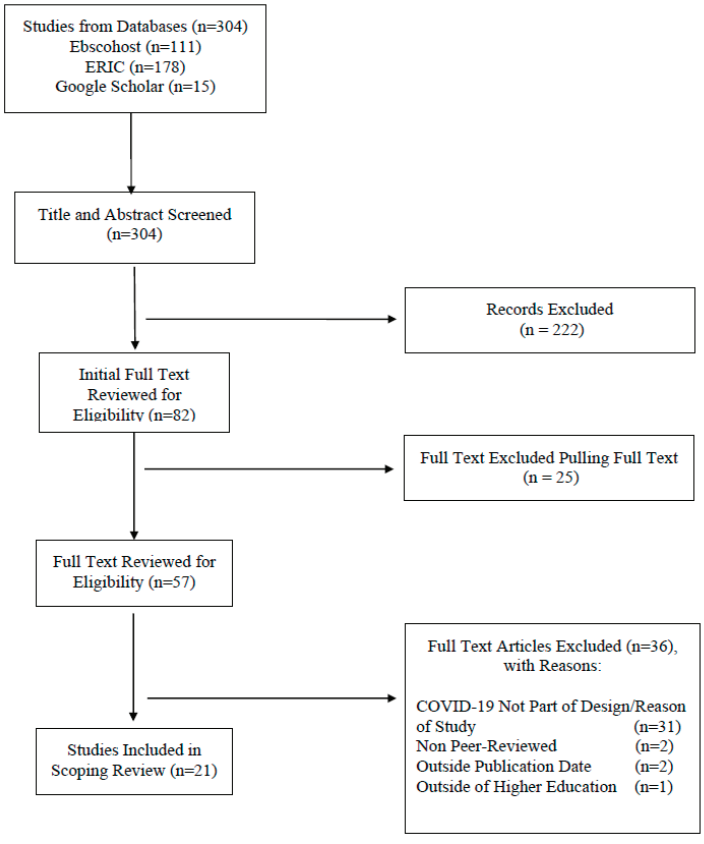

Figure 1. PRISMA diagram.

2.4. Charting, Collating, and Analyzing the Data

Four researchers participated in extracting data from the resulting articles for analysis (G.L., G.W., P.M., and T.W.). Each researcher reviewed the articles to identify data relevant to the scoping review question for further consideration. To facilitate data analysis, data were extracted and entered into a Google template. Columns within the template were labeled to facilitate data extraction for analysis and included the following headings: authors, publication title, publication year, article type, discipline of application, countries involved, level of higher education, course of application, competencies targeted, model details, study type, durations of intervention, study population, study aims, methodological overview, results, and the question of how this article relates to the scoping review. Once all data were entered into the Google template, information was transferred by column into Jamboard pages by creating sticky notes for each entry The titles for each Jamboard corresponded to the titles from the Google template used for data extraction. This process allowed the full research team to visualize the data together, both asynchronously and in successive Zoom meetings, to collaboratively develop descriptive and thematic results. For descriptive results, one researcher consolidated the information on a given Jamboard page (P.M.), wrote a narrative description of the findings, and gained consensus from the team on the graphic representation of those findings. Then, another researcher (G.W.) created graphics representing the descriptive findings. For the thematic analysis, three researchers each took one of the three sub-questions posed (G.L., G.W., and P.M.), analyzed the Jamboard related to the question, wrote an initial summary of the findings, and gained consensus from the research team.

3. Findings

3.1. Descriptive Analysis

3.1.1. Article Types

Various article types were considered in this review, as shown in Table 2. Five of the twenty-one were theoretical or conceptual articles [8–12]. The majority of the articles, 13, were peer-reviewed research studies [13–25]. Of these studies, eight employed qualitative methods [13,15–17,19,23,25,26]. Within these eight studies, specific qualitative methods ranged from thematic analyses of open responses in surveys and entries in student journals to a content analysis of bibliographic search data, interviews, an appreciative inquiry, and autoethnography. One article employed a quantitative pre/post survey design [18]. Eight studies adopted mixed-methods approaches combining descriptive statistics or an analysis of surveys/questionnaires with either qualitative interviewing, a thematic analysis of open-ended survey/questionnaire responses, a thematic analysis of student reflections, or a document analysis [10,14,20–22,24,27,28].

Table 2. Article types.

Articles	Year	Theoretical	Research	Qualitative	Quantitative	Mixed Methods
Ala-Kortsma et al. [13]	2023		X	X		
Alami et al. [14]	2022		X			X
DeKlerk et al. [8]	2022	X				
delaGarza et al. [9]	2022	X				
Devereux et al. [10]	2022	X				X
Giralt et al. [15]	2022		X	X		
Gleason et al. [16]	2021		X	X		
Golubeva et al. [17]	2022		X	X		
Guimarães et al. [26]	2021			X		
Inada [18]	2022		X		X	
Ismailov [27]	2021					X
Jacobs et al. [19]	2021		X	X		
Krengel [11]	2021	X				
Lenkaitis [20]	2022		X			X
Liu and Shirley [21]	2021		X			X
Nyunt et al. [12]	2023	X				
Oggel et al. [28]	2022					X
Poe [22]	2022		X			X
Weaver et al. [23]	2022		X	X		
Whatley et al. [24]	2022		X	X		X
Wimpenny et al. [25]	2022		X			
Total		5	13	8	1	8

3.1.2. Populations of Focus

Of the research studies in this review, an analysis revealed three populations in focus. Three articles researched IVE at the institutional level [15,24,25]. These studies varied from typologies [24] to the accreditation of IVE offerings [15] and decentralizing hegemonic norms in global North/South tensions [25]. Two articles focused on instructors and ad-

ministrators [15,23]. These studies aimed to investigate inclusive program design [15] and faculty capacity-building and prior international experiences [23].

3.1.3. Publications by Year

Of the twenty-one studies considered in this review, six were published in 2021 [11,16,21,26,27]. Thirteen articles were published in 2022 [8–10,14,15,17,18,20,22–25,28]. Two articles reviewed were published in 2023 [12,13].

3.1.4. Countries Involved in IVE Application

Twenty-two countries were represented in sixteen of the articles that addressed the application of IVE in specific courses or programs [10–13,16–25,27,28]. The United States was most represented in 10/16 articles; South Africa was represented in 3/16; Argentina, Brazil, China (including Hong Kong), Germany, Japan, Netherlands, Turkey, and the United Kingdom were represented in 2/16; and Canada, Colombia, India, Iraq, Italy, Jordan, Liberia, Poland, Russia, Spain, and Sweden were represented in 1/16.

Seven of the articles for review did not consider the application of IVE in a specific program or course; rather, they critiqued or provided theoretical insight for the application of IVE across higher education [8,9,12,14,15,19,26]. Three considered the Collaborative Online International Learning (COIL) model of VE to be appropriate across higher-education entities [8,19,26] with [8] specifically noting how COIL aligns with all students with disabilities. Jacobs and colleagues [19] presented faculty reflection on developing COIL partnerships during the pandemic, emphasizing future curricular innovation and partnering with a focus on decolonization. Similarly, delaGarza et al. [9] considered GVE across Latin American countries regarding the decolonization of film education. Alami et al. [14] consider the application of IVE across geopolitical sectors in South and Central America. Finally, Nyunt et al. [12] addressed how to use theory to enhance faculty development toward deepening student learning in IVEs.

3.1.5. Academic Disciplines

Thirteen articles considered the application of IVE in specific courses or programs [9–12,16–21,23,27,28].The disciplines represented were Agriculture [10], Business [18,21], Communication [13,17], Computer Science [23], Education [11,16,20,23], Engineering [21], Film studies [9], Language Studies [17,28], and Social Psychology [17,28]. Among these publications, four articles represented interdisciplinary applications in varied exchanges based upon institutional partners [17,21,23,28]. The remaining nine articles considered applications within similar courses by exchange partners. (Table 3).

Table 3. Academic disciplines.

Articles	Year	Agriculture	Business	Communication	Computer Science	Education	Engineering	Film Studies	Language Studies	Social Psychology	Interdisciplinary
Ala-Kortsma et al. [13]	2023			X							
Alami et al. [14]	2022										
DeKlerk et al. [8]	2022										
delaGarza et al. [9]	2022							X			
Devereux et al. [10]	2022	X									
Giralt et al. [15]	2022										
Gleason et al. [16]	2021					X					
Golubeva et al. [17]	2022			x					x	x	X
Guimarães et al. [26]	2021										
Inada [18]	2022		X								
Ismailov [27]	2021										
Jacobs et al. [19]	2021	X									
Krengel [11]	2021					X					
Lenkaitis [20]	2022					X					
Lui and Shirley [21]	2021		X				x				X
Nyunt et al. [12]	2023										
Oggel et al. [28]	2022								X	x	x
Poe [22]	2022										
Weaver et al. [23]	2022				x	X					x
Whatley et al. [24]	2022										
Wimpenny et al. [25]	2022										
Total		2	2	2	1	4	1	1	2	2	4

3.1.6. Competencies Targeted

Ten articles focused on intercultural competencies (language skills, cultural sensitivity, and global appreciation) [13,16,17,19,20,22,23,27,28]. Others focused on another set of competencies related to career readiness (collaboration, facilitation, leadership, social entrepreneurship, and team building) [11,12,17,18,21,23,27]. Moreover, there was a focus on developing digital and technical competencies for intercultural and global collaborations [16,17]. Our thematic analysis addresses how the competencies of focus relate to the questions posed for this review. (Table 4)

Table 4. Competencies.

Articles	Year	Intercultural	Career Readiness	Digital and Technical for Intercultural and Global Collaborations
Ala-Kortsma et al. [13]	2023	X		
Alami et al. [14]	2022			
DeKlerk et al. [8]	2022			
delaGarza et al. [9]	2022			
Devereux et al. [10]	2022			
Giralt et al. [15]	2022			
Gleason et al. [16]	2021			
Golubeva et al. [17]	2022	x	x	X
Guimarães et al. [26]	2021			
Inada [18]	2022		X	
Ismailov [27]	2021	x	X	
Jacobs et al. [19]	2021	X		
Krengel [11]	2021		X	
Lenkaitis [20]	2022	X		
Liu and Shirley [21]	2021		X	
Nyunt et al. [12]	2023		X	
Oggel et al. [28]	2022	X		
Poe [22]	2022	X		
Weaver et al. [23]	2022	X	X	
Whatley et al. [24]	2022			
Wimpenny et al. [25]	2022			
Total		8	7	1

3.2. Thematic Analysis

3.2.1. Facilitations of Intercultural Awareness

For this theme, ten articles focused on the application of IVE for increased individual awareness of different cultural perspectives [13,16,17,19,20,22,23,26,28,29]. While [13,16,22,23,28] demonstrate how IVE can promote intercultural awareness, communication, and knowledge.

In particular, several of the authors focused on the student learning aspect, utilizing existing frameworks. Lenkaitis [20] utilized technology to build teacher competence in exercising cultural sensitivity with students and knowledge of global issues, using the United Nations' (UN) Sustainable Development Goals (SDGs) framework as a reference. Similarly, Golubeva et al. [17], with the aim of improving intercultural curricula, applied the Reference Framework of Competences for Democratic Culture (RFCDC) to analyze existing student assignments for emerging competencies represented.

Additionally, Gleason et al. [16] emphasized forming connections at the personal level through finding common ground and understanding different perspectives on a global scale. Similarly, Weaver et al. [23] emphasized the need for humility (both culturally and professionally) in interpersonal interactions, and Poe [22] demonstrated how IVE can result in a reduction in bias and increased affinity for people outside of a home country.

With Wimpenny et al. [25] even went so far as to suggest that IVE can create a new pedagogy that overcomes cultural North/South divergence, creating a "Third Space" that allows for the creation of an environment for cultural understanding. From an institutional perspective, Jacobs et al. [19] argued for global approaches to promoting interactions among course facilitators for the purpose of implementing IVE in a decolonial and reciprocal manner. And Guimarães et al. [26] also highlighted how IVE can allow for the development of global citizenship and the potential for a "Third Space".

While these studies indicate that COVID-19 spurred the acceleration of IVE application, collectively, these articles address facilitators of intercultural awareness in the context of COVID-19, but these facilitators are not bound to be solely used or applied within a pandemic. Rather, the use of IVE can be applied as a blueprint for the utilization of IVE beyond its use during the pandemic to address topics of global citizenship development, interconnectedness, and common understanding to address the bifurcation within the North/South cultural divergence.

3.2.2. Collaborative Engagement and Thinking

Three articles provided considerations for the potential of IVE as a means to promote higher-order collaborative engagement and thinking, particularly relating to topics of decolonization and biases related to inequities in the conceptualization and implementation of IVE between the global North and South [14,25,26]. While Guimarães andFinardi [26] noted that "neutral White, global North, middle class, male normativity" (p. 2) is still the centered norm and offers the possibility of a "glonacal" (p. 3) focus, that is, accounting for the role of the state (at the national level), as well as global and local contexts, as an alternative Third Space that can encourage critical reflexivity and which disrupts Western-focused notions of knowledge, identity, and values.

Wimpenny et al. similarly discerned that the IVE model seeks to aid in "developing a series of attributes, qualities and capabilities that enable students to address and reflect upon the challenges of living and working in contemporary societies as global citizens and professionals" [25] (p. 280). Leveraging digitalization in a cross-disciplinary and multicultural strategy while working to address social challenges allows for IVE offerings to situate themselves as Third Spaces which can contest the dominance of traditionally hegemonic Western ideologies and pedagogies. However, the authors also caution being mindful of how inequities can be replicated if educators are not intentional in their program design.

Alami et al. [14] observed that the COVID-19 pandemic demonstrated both how a lack of technological access exacerbated inequalities and simultaneously created additional inequalities through exclusion and marginalization. One particularly interesting finding was that for the regions North America, Europe, and Africa, the top challenge for IVE programs was that there are often no incentives for implementation despite the numerous benefits described in the previous section. There is often a clear power imbalance in how IVE is typically conceptualized—with a Western university (particularly from an English-speaking country). Authors suggested training on IVE pedagogies across disciplines and contexts to help remedy this imbalance.

Collectively, these articles attest to the possibilities IVE offers as a medium for collaborative engagement and thinking while simultaneously cautioning against unreservedly viewing IVE as a simple solution to long-standing inequities. In this sense, they continue long-standing critiques of Allport's [29] contact hypothesis and advocate for intentional program design and implementation. Though more institutions are now conceptualizing IVE as a viable strategy for internationalization at home, attention to factors such as digital capital alongside other capitals of resonance such as cultural and social capital will be

necessary considerations. IVE as an internationalization-at-home strategy is still not as accessible as some studies suggest (particularly between the Global North–South), and in addition to the significant time and effort needed to build quality IVE partnerships, awareness of IVE and institutional incentives for partnerships remain uneven across all regions. Future IVE programs and research will likely continue to interrupt Western and Global North-dominant paradigms, create a greater awareness of IVE as a possible medium for inclusive educational collaboration, and aid in the refinement of competencies such as global citizenship.

3.2.3. IVE and Equity

With many study-abroad programs canceled during the COVID-19 pandemic, IVE offered the potential for intercultural exchange to continue and to perhaps expand to increase access to a broader demographic of students. Yet articles within this review also indicate cautions to ensure equitable access moving forward. The content of four articles related to how the application of IVE during the COVID-19 pandemic addressed challenges related to the digital divide and access to the equitable use of technology [8,14,24,25]. An analysis did not identify any articles that specifically researched the outcomes of IVE in relation to the digital divide. However, in examining the Global North/South application of IVE, Wimpenny et al. [25] cautioned for adopting digitization practices promoting access and the careful consideration of the technological requirements for participation. As previously noted, these authors suggest the potential of IVE to emancipate higher education from hegemonic pedagogy and provide an inclusive "Third Space" (p. 279) where in which new ways of knowing and learning can thrive. However, they also emphasize the importance of non-hierarchical relationships (academic–academic; student–student) and valuing collective development as the ideal starting point for equity and inclusion in the application of IVE.

Three additional articles either investigated equitable participation in IVE or made recommendations to increase access to minoritized populations. Where Whatley et al. [24] presented a case study that described a typology of the application of IVE across two community colleges in colleges in North Carolina. Structured applications of IVE included collaborative, project-based applications, videoconference dialogue, open enrollment, asynchronous exchange, and one-on-one language learning practice aligned to specific academic credentials and outcomes. Less-structured applications included open-enrollment international exchanges, at times open to the local community, which were often funded by the community college on the students' behalf, which increased the opportunity for participation. The predictors of participation in IVE, as compared to traditional study-abroad programs, related to racial/ethnic identity, the receipt of Pell funding, and students' degree programs (an Associate degree in Arts or Science influences participation in IVE). The finding that students from lower economic status (recipients of Pell grants) were more likely to participate in IVE suggests the potential future application of IVE to ensure access to students who may not be able to afford traditional study-abroad programs. The findings related to degree declaration suggest that expanding IVE offerings across traditional degree programs would also expand access and encourage participation. To encourage equitable participation, this expansion should include programs with enrollment from diverse racial/ethnic and socio-economic backgrounds.

Alami et al. and deKlerk et al. [8,14] address inclusivity and IVE. In a mixed-methods study, Alami et al. [14] considered the challenges to applying IVE as a mechanism for more inclusive international education, considering five geo-political regions. According to their findings, the top five global challenges were the time and effort required to develop VE, an incompatibility of partners' preferred technologies, a lack of incentives for implementation, national or international political regulation, and a "lack of processes for curricular change" (p. 66). While there was variation in challenges by region, the study yields recommendations that can be applied globally, such as increasing global recognition of VE benefits and providing training in IVE design and implementation for faculty and administration,

with a focus on inclusivity and equitable participation by minoritized populations. A specific suggestion includes the development of IVE ambassador roles to assist faculty with curriculum internationalization processes and implementing policies and incentives for designing IVE initiatives. Similarly, deKlerk et al. [8] theorize the potential for increased equity and inclusivity in the application of IVE, with a focus on students with disabilities. The authors theorize how open distance learning (ODL), when aligned with appropriate pedagogy, can create transformational learning experiences for students living with disabilities. The broader application of IVE could allow students with disabilities the opportunity to collaborate in learning environments that are currently inaccessible. When creating these ODL opportunities, institutions should adopt inclusive technologies that enable access for this student population.

Collectively, these articles indicate IVE application during the pandemic from global to local contexts, suggesting insights into how to increase equity and inclusivity in higher education in the post-pandemic landscape. Case studies indicate that creating IVE opportunities across degree programs might encourage participation by diverse student populations and confirm that IVE can be a conduit to international learning for students of low economic status. Similarly, when institutions of higher education adopt inclusive technology and align IVE with collaborative and transformative pedagogy, it can empower students with disabilities to experience education in new ways and, potentially, life-changing ways. Yet institutions must also carefully consider the technology and pedagogy guiding the increased adoption of IVE for these purposes and must also properly prepare faculty and administrators for IVE design and adoption.

4. Discussion

The emergent themes presented within this scoping review continue to illuminate the role of IVE in serving as a modality for developing intercultural awareness, global collaborative engagement, and the ongoing adoption of technology for international education exchange. However, the literature indicates new adaptations, innovations, and equity considerations that emerged in response to the disruptions caused during the pandemic which continue to have lasting effects today. Moving forward, these results have implications for practice and research beyond pandemic practices and can serve as a needed roadmap beyond the pandemic.

Within this scoping review, it became clear that adaptations of both mobility-based programs and on-campus curricula were carried out to respond to disruptions to global learning during the pandemic. With these adaptations, new technological tools and infrastructure emerged to carry out and scale IVE with a focus on facilitating the exploration and resolution of wicked problems or those related to international development goals (i.e., UNSGDs). However, the future utilization of this technological infrastructure and its usage for advancing curriculum and pedagogical change are yet to be explored. Future studies should both consider innovations present in the dynamic space of technological innovation and examine the effects of technological fatigue and "back-to-normal practice" that occurred during this period that can limit the growth of IVEs.

The articles represented here indicate two important aspects of global connectivity. First, the articles highlight the ways in which technology can be used to strengthen existing partnerships in traditional locations. It was clear from the literature that IVE can not only maintain and create sustainable ties with international partners that add depth and richness and move beyond brief, extractive sojourns but also have the opportunity to create meaningful, lasting collaborative spaces for the ongoing expansion of global activities. Secondly, the research here shows that technology is allowing for connections to locations typically outside mobility-based programming that can provide new avenues to address and disrupt North/South power dynamics. Through IVE, new cultural communities can be incorporated into internationalization practices including both new locations within commonly traveled destinations (e.g., outside of a Western capital city) as well as new countries and locations long on the periphery of international exchange. These new

destinations offer an opportunity to complicate notions of who is included in global reckoning with colonial legacies embedded within international education, but they can also create new complications related to the digital divide. Addressing challenges related to the digital divide, incentives for engaging in IVE, and access to the equitable use of technology should each be a central focus of the research to come.

These articles move research and practice beyond the course- or case-specific examples of pedagogical innovations that were seen in pre-pandemic studies on IVE to focusing on mechanics, tasks, partnerships, scaling, and diverse outcomes. At the curricular level, the research represented here highlights the efforts undertaken to move beyond singular or small curricular innovations to expanding reflective approaches to create just and sustainable programs at scale. Additional research addressing the need for pedagogical innovations that incorporate IVE and the use of education technology are needed as the field seeks to enhance student learning and move towards transformational pedagogy in the current era. This research offers future facilitators and implementers a roadmap for creating lasting, equitable partnerships that are part of a comprehensive approach to internationalization which intentionally integrates global learning into the curriculum and strengthens the model and empirical evidence needed to advance the field of IVE.

Limitations are present within this scoping review. Given the need to capture a timely event in history, this review provides only a snapshot of the emerging innovations occurring in IVE. Many studies on IVE that showcase innovations that address equity considerations or the application of IVE for intercultural awareness were removed as their research or adaptation was not directly associated with the pandemic. A further review of the more than 300 articles that emerged in the first rounds of this analysis will likely provide new insights into the literature outside the scope of this review that addresses innovations during the COVID-19 pandemic. Additionally, many of these studies focused on qualitative data at the institutional level. While these are helpful, a more diverse body of research will need to emerge to understand the vastness of innovations in this area. Lastly, it is likely that many articles about innovations in IVE during this timeframe remain in the pipeline as the pandemic disruptions continue to have lingering effects. An updated scoping review in the future will be needed to capture future studies more comprehensively as we seek to understand the lasting impacts of the COVID-19 pandemic on IVE and, more broadly, on internationalization practices.

5. Conclusions

This scoping review provides the field with a rich set of innovations in IVE practice within the classroom for intercultural awareness amongst collaborative partners and within the evolving nature of the systems needed to sustain and scale IVE. At the same time, we can see that IVE does not resolve all the issues embedded in the current international education exchange practice but creates its own set of challenges, particularly around equity and access, that will need to be addressed in future research, policy, and practice. What is clear is that IVE is now its own modality that is an integral part of global learning practice embedded within the emerging arena of *digital internationalization* [30]. The use of technology to advance innovative, international curricular and programmatic adaptations during the pandemic launched IVE into mainstream practice, and IVE is here to stay. The articles in this review highlight the potential of IVE in higher education as a mechanism for the knowledge and skill development required by a global ecology.

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Article

Connecting Prescriptive Analytics with Student Success: Evaluating Institutional Promise and Planning

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Abstract: Data-driven educational decisions enabled by online technologies hold promise for improving student performance across the full range of student dis/ability, even when efforts to design for student learning requirements (such as through Universal Design for Learning) fall short and undergraduates struggle to learn course material. In this action research study, 37 institutional stakeholders evaluated the potential of prescriptive analytics to project student outcomes in different simulated worlds, comparing hypothetical future learning scenarios. The goal of these prescriptions would be to make recommendations to students about tutoring and to faculty about beneficial course redesign points. The study's analysis focused on the alignment of resources, processes, and values for feasible institutionalization of such analytics, highlighting institutional core values. In the postpandemic mix of online and on-campus learning under increasingly constrained resources, educational leaders should explore the potential competitive advantage of leveraging data from online technologies for greater student success.

Keywords: student success; prescriptive analytics; action research; online education

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1. Introduction

When higher education leaders begin a new analytics initiative involving machine learning, stakeholders play a key role in determining what design to adopt when closing the loop to provide students with feedback [1,2]. These stakeholders may hold a range of views about the utility, efficacy, optimal design, and importance of such an initiative that would potentially impact its implementation and success. When evaluating a proposed project for potential adoption, leaders and managers interested in data-informed decision making need to understand the project's value to the institution and its constituents to determine whether it warrants the resources required [3]. If stakeholders who would potentially use the analytics do not see the value of the initiative or its practicality for aiding their decision making and practice, they may not use what eventually becomes available to them. This would undermine the institutional value proposition.

Therefore, stakeholder voices became a key component in a human-centered design approach for a novel prescriptive analytics application in the present research. This research's overall initiative aims to support students who would benefit from receiving recommendations for tutoring, and relatedly, to support course redesign efforts by identifying where students struggle most. From a co-creation perspective, I involved stakeholders intentionally throughout the project's design and development, guiding each step toward implementation [4]. This research study explored one step of this process, assessing alignment with the institution's core values.

This case study took place at a small, private, women-only institution of higher education in the northeastern United States. Recently, the institution was ranked highly among regional universities for advancing social mobility [5], and is an emerging Hispanic-Serving Institution (HSI), underscoring its commitment to supporting its diverse student body. To help students succeed, the university leverages technology, including online applications, and provides extensive wraparound support for students through a unique holistic

model [6]. This support extends the university's extensive on-campus services for more traditionally oriented undergraduates to the predominantly non-traditional students who attend the online arm of the university. To help the university provide cost-effective and substantively effective support to students, the institution values data-informed decision making and has a history of developing analytics applications to inform practice at an institutional level, such as with retention efforts [7].

Educational leaders have shown interest in expanding analytics to inform teaching- and learning-related decisions [8], such as the prescriptive application considered in this study. This application is facilitated by the existence of a data warehouse that aggregates data from multiple campus systems, including the adaptive learning system, the learning management system, the student information system, the online tutoring system, and the advising system, among others. The rich data available offer the opportunity to generate meaningful feedback for students on their educational progress and practice [9]. This proposed analytics application would be co-designed with institutional stakeholders to provide feedback to students to inform their on-the-fly decisions regarding whether to seek additional tutoring support at points in a course when they are struggling to learn the material.

Importantly, as context for this study, the institution has undertaken an in-depth and inclusive determination of its core values. The university president initiated this process as part of a strategic effort to bring the online and on-campus components of the university into greater alignment (Email communication, 2021). A multifaceted, institution-wide discovery process involved a core committee with 15 representatives from across the campus, a campus-wide survey, and focus groups that were open to the community. After a five-month process, including data analysis, core values were articulated in February 2022 [10]. Since then, various practices have moved the institution intentionally toward incorporating these values into daily discussions, conversations, events, awards, and student activities. Thus, a conversation about aligning the proposed prescriptive analytics initiative with institutional values proceeded from a common foundation, which is unusual in co-designed learning analytics initiatives. As Dollinger et al. [4] noted, "The current gap in the literature relating to participatory design in LA is not the lack of interventions, but rather the transparency of the researchers'. . . values. . . underpinning their decision-making" (p. 12). This study addresses this gap by exploring the way stakeholders see their values pertaining to this analytics initiative.

The research question that guided this study was as follows: How would institutionalizing a prescriptive analytics approach offering students support within courses align with institutional core values?

2. Literature Review

Prescriptive analytics, as investigated here, is an approach not yet widely developed or adopted in higher education. It presents an opportunity for research and development, and a competitive advantage for institutions if executed well. Despite the promise of prescriptive analytics for comparing potential student outcomes in simulated worlds [11], learning analytics applications to date have typically focused on descriptive or predictive analytics or evaluation [12–14]. When mentioned, prescriptive analytics has been recognized as an opportunity for institutions interested in making more effective use of existing data [15]. For example, educational leaders can now use student learning data aggregated from across multiple campus systems in data warehouses to support analytic directions involving calculating potential outcomes using Bayesian network modeling. This approach facilitates the investigation of optimal decisions while accounting for uncertainty, particularly when combined with the knowledge mapping that accompanies adaptive learning system implementation [16]. Many opportunities exist for expanding use of data and analytics applications and building further capacity within higher education [17,18], and prescriptive opportunities hold promise as one avenue for further investigation.

This study focuses on the alignment of institutional core values with the implementation of prescriptive analytics to support students. These values are a key component underpinning the realization of technological innovation in practice. The resources, processes, and values (RPV) change management framework describes organizational innovative capability as shaped by key elements that include the values that provide the context for institutional data-informed decision making [15,19]. When implementing a significant innovation with the potential to change how an organization conducts its operations substantially, leaders need to determine necessary resources and identify and enact processes for implementing the innovative initiative. The organization's values act as an umbrella over all parts of the project, impacting the overall success or failure of the initiative. As described in the Learning Analytics in Higher Education Adoption Model [20], organizational factors, such as those highlighted by RPV theory, play a key contextual role in analytics adoption efforts leading to the user reflection, ongoing engagement, self-assessment, and action necessary for effective implementation.

Supported by RPV theory's emphasis on the role of organizational values in shaping practical, innovative capacity, I determined that assessing the project's feasibility should involve stakeholders exploring how and whether the institution's core values aligned with the proposed initiative. According to RPV theory, the organization's values govern the standards used to judge the attractiveness of innovative opportunities [19]. These values determine how stakeholders engage with the project and whether the project supports key performance indicators that matter to institutional decision makers. They also determine whether those administrators will see the project as aligning with the institution's strategic direction, likely to succeed, and supported by the community.

This values emphasis is combined here with an understanding of appropriate stakeholder involvement. In a learning analytics context, the simplified Orchestrating Learning Analytics (OrLA) framework represents a view of critical issues that need stakeholder communication for a successful analytics initiative specifically involving applications to learning [1]. These include understanding local issues, current practices, affordances provided by the enhanced technology, the innovation itself, and ethics and privacy issues. These factors all feed into a cost–benefit analysis or, as described in the present study, a feasibility analysis. OrLA posits that stakeholders who provide input to this analysis could include practitioners (e.g., faculty and staff), students, system developers, researchers, and legal experts. Such stakeholder considerations are particularly salient for a study like the present one, which aims to close the loop and provide useful feedback to individuals (i.e., users).

In the present case, the institution initially created its online arm as a separate operation targeting a distinctive population of students (i.e., non-traditional) who valued the additional flexibility of online learning and appreciated additional technological supports such as adaptive learning [8]. As the institution works to integrate what has been learned through this online initiative into the main operations of the university (i.e., a current strategic priority), the conversations around values take on particular importance. The shared values across innovative and traditional modes of teaching and learning focus everyone on what matters most, moving past surface differences to the heart of what is important in the learning environment.

The present core values-focused study constitutes one component of a larger project investigating all three RPV framework components: resources, processes, and values. Because of the central importance of values alignment to determining the sensibleness and feasibility of the project overall, particularly in the context of Bay Path University's evolution and merging of online and traditional educational modes, the present study focused on the values component of the model, highlighting the richness of results connecting the proposed project to the institution's core values. In line with the stakeholder groups the OrLA model indicates are relevant to assess a project's feasibility, this project involved faculty, staff, students, systems people, and me—the researcher.

3. Methods

An action research approach was taken involving participants in a series of focus groups that each included a different mix of stakeholders [21]. In action research, participant voices drive the research. Thus, this methodology was appropriate for this study centering human-oriented design processes [22]. This approach facilitated emphasizing stakeholder input into design direction and design decisions [23]. Action research often occurs in iterative cycles of investigation, and the individuals engaging with this study participated in two cycles. The core values data analyzed here are from the first action research cycle. The second action research cycle more deeply investigated the resources and processes needed and is reported elsewhere.

In action research, the researcher is an actor along with the participants. As such, reflecting on my role and how I might influence the results is important for ensuring study quality, particularly given my connections to the institution [24]. As the researcher, I have had several connections to the institution over time, including as a faculty member when these data were collected. I have also analyzed data from the institution for grant project assessments and other independent research. I developed prior connections with some, but not all, participants in this study. No participants directly worked with or studied in my teaching area during data collection, and I have since left the institution to teach at another university. Thus, my analysis was conducted after I left the setting, giving me both insider knowledge and external perspective on the proposed project being investigated as I strove to engage in rigorous analysis to understand the participants' perspectives.

In reflecting upon my role as an insider action researcher during data collection, I recognize that my role as an invested community member may have increased my credibility with the participants. It also gave me insight into what kind of project would be of interest to stakeholders, informing the project framing [25]. Though I endeavored to facilitate participants sharing their views, it is possible my dual role may have influenced what they shared in unknown ways. Although my connection to the university may have thus influenced my engagement with the participants and the resulting analysis, I have endeavored to be reflective about my practice and my role in the research to minimize such potential effects and instead amplify the participants' voices in the results.

4. Data

The data analyzed come from a series of 10 focus groups that I conducted in Spring 2023 involving 37 institutional stakeholders. Participants included 17 students, 7 faculty members, and 13 staff, each paid a small stipend for their participation (see Table 1).

Table 1. Participant characteristics.

Role	Online	on Campus	Both Online and on Campus	Total
Students	8	5	4	17
Faculty	1	6	0	7
Staff	3	0	10	13

Study participation was open to anyone at the institution, but the sample was primarily generated through purposeful sampling of people with different roles with the goal of obtaining wide sample variation. Stakeholders involved with both online and on-campus education were engaged in the study, so potential differences between the student experience in these different modalities could be identified. Students came from a variety of majors, including fields related to business, health, communications, and psychology. Faculty came from various departments, which are not identified here to keep the respondents anonymous, given the university's small size.

Other characteristics were not systematically identified, but the focus group discussion clarified many. Several participants were peer mentors and several had disabilities–I specifically reached out to both groups with invitations because they were expected to have

insightful perspectives on the topic under study. At least two participants were on the Core Values Committee, and two others were Core Values Ambassadors for the campus. Some students had used either online or on-campus tutoring, and others had not. Students ranged from first-year students to seniors; some were traditional age, and others were not. Some lived on campus, others near the university, and yet others in various states around the country.

Each participant attended one first-round focus group concentrated on the core values, lasting an hour and a half. These ten focus groups contained anywhere from two to six participants. Six groups contained a mix of students and others; one contained a mix of faculty and staff, one contained only staff, and two contained only students. Groups were mostly of mixed composition, allowing participants to hear other viewpoints and spark ideas. Even groups that were all staff or all students had people from different functional areas or student backgrounds, providing a diversity of opinions. However, these more homogenous groups also allowed for a deeper dive into the issues most salient to that type of participant.

5. Analysis

Focus groups were recorded on Zoom and transcribed using the assistance of otter.ai. Transcriptions were reviewed and corrected by the researcher, beginning the process of immersing myself in the data. Corrections included things like the names of programs or acronyms specific to the institution. Anonymized summaries of each focus group discussion were sent to that group's participants as a member checking exercise, involving the participants to ensure the accuracy of the participant voices quoted in the results and bolstering the trustworthiness of the findings overall [26]. After this review by the members of each focus group, the summaries of all focus groups were shared with all participants.

During the analysis, I conducted coding by hand via multiple passes through printouts of sixteen pages of single-spaced, transcribed data, a process during which I familiarized myself with the nuances of the data and sought patterns. (I note that other data from these focus groups were not analyzed for this study because they involved discussion that did not pertain directly to the core values.) After reviewing all transcriptions, an open coding cycle through the data identified major topics discussed using descriptive codes and in vivo codes based on statements by the focus group participants [27]. I followed this step with a second cycle of focused coding, looking for patterns specifically within each core values area identified by the institution [28]. I remained reflective about how my role as the researcher and sole coder might affect the results. In doing so, I engaged in contemplation and memo writing, aiming to understand and minimize my potential impact on the results beyond my role as the focus group facilitator and the explanations of the proposed project that I provided to the participants. Consistent with this orientation, I foregrounded participant views in my presentation of the findings. My investment in the process of improving practice at the institution was mirrored in the participant voices in a way that seems authentic to the institutional ethos. My reflexive practice was undertaken with the aim of bolstering the credibility of my findings for a study with a single coder. I categorized results thematically within each core value area and across all areas, as presented next.

6. Results

In addition to making specific observations about individual core values, some participants felt the project related to all core values. This was encapsulated in a theme of cross-cutting core relevance. For example, some participants saw the project aligning well with the core values overall, saying that "it really touches on most, if not all of them", and "I do believe that the analytics line up with the core values 100%". The project was also seen as supporting administrators' efforts to foster student success:

> I see it as such a benefit to the core values like because we're taking, the administrators and everything at Bay Path are making every effort for those students

> to succeed. And you want to support them any way you can, throughout their whole journey. I think it's amazing. I think it's a good, very good idea. And it does, I think it matches great with the core values, all of them.

Another participant concluded: "But analytically speaking, I mean, to be honest, all this is gonna focus on these values, no matter what, you know, whichever avenues that you choose to take. On the end, they all come together as one anyways". As these comments illustrate, there was wide support for the application of the core values within a prescriptive analytics initiative. This support for cross-cutting core relevance was found among both people who had been involved directly in the core values initiative and others who were not.

This enthusiasm was countered by one person who expressed skepticism, saying:

> You can't interact with the instructor while you're in class to ask questions, and whatnot. That's the biggest hurdle for me, as somebody that does have issues in general, like, I will disclose, I do have ADHD, I have anxiety, I have depression. I have all those that all are also incorporated into my challenges with the courses. So lately, they've been making it very difficult with attending to the course load and everything. It's not that I can't get the material down, it's just the fact that the time that I give and contribute to my courses is very difficult, especially when I don't have a lot of energy. And I don't think that with analytics itself, it will take that into account, because it's just looking at the grades of the student. So you don't really know the backstory behind the student as well, which I know that's another concern with these things.

Another person expressed both skepticism and enthusiasm, demonstrating a complexity of feelings:

> It doesn't feel like the campus actually implements those. It feels like it's being promoted but not implemented. Like while seeing learners come first, it doesn't feel like it as a person of color on campus. We pledge to foster inclusion and belonging, but it doesn't feel as though. So I feel like things like that. . . . This is aligned with these core values. I think that they're really good qualifiers. I just wish that they were more implemented within the campus. Like I said before, it feels along the lines of marketing and feels like it's being stated, but not actually done.

Thus, these and other findings below show a range of opinions, leading to another theme of the importance of multiple perspectives. This points to the importance of continuing to have diverse voices engaged in the next steps of the project.

The subsections below present results from the student, faculty, and staff discussions of each core value. In terms of prevalence of responses, the core values of "our learners come first" and "committed to equity" stood out as the most frequently identified, typically with passionate thoughts. "We are a community that collaborates" and "innovation and excellence" were also mentioned quite frequently. The values of "respect and compassion", as well as "health and well being" were mentioned less frequently, though sometimes with great passion. "Diversity makes us stronger" and "fostering inclusion and belonging" were mentioned by the fewest people. In what follows, I foreground the voices of the study participants to share their perspectives on the primary themes related to each core value.

6.1. Core Value: Our Learners Come First

The primary theme in the responses noting "our learners come first" was as follows: help students by making currently invisible patterns visible. Example quotes that illustrate this theme included the following:

> There is so much about learners that should be taken into account—their background, their learning styles, where they are in their education (right out of high school or coming back to education), whether they work. Diversity incorporates

> a lot of different things, including gender and race, but also diversity in learning, such as neurodiverse learning, as well as diverse activities, such as multicultural events, academic gatherings that aren't classes, and clubs or activities.
>
> Our learners come first is really important to look at, because you're trying to improve the experience for the population as a whole. But each individual needs to be looked at, because the data doesn't necessarily reflect each individual's needs, it reflects the needs of a larger group.
>
> I think the first one, our learners come first, is huge. . . I think that kind of goes hand in hand with the predictive analytics if anything can help our learners learn better. . . coming at it from different directions kind of just looking at what the data shows and how we can use that to help them improve in any aspect of their learning is big.

6.2. Core Value: Diversity Makes Us Stronger

The primary theme in the responses around the core value of "diversity makes us stronger" was as follows: diversity should be reflected throughout. Example participant quotes included the following.

> When we use analytics, we should "perhaps have a variety of them. Because having the diversity [in the modeling], that would be better able to address the diversity of our students".

Another participant discussed not growing up in the United States and the difference in her education:

> We don't all learn the same. If we're going to talk about diversity in America, we need to consider the students that we should include—that they might not learn the same, that they might need more support. . . . Those folks that do better with a visual understanding could benefit from a dashboard, but then I can see how the support from the faculty, it's what actually takes it all the way. So we need to consider that not everyone comes from the same background set. Because of it, we don't all learn the same. So if we're going to be inclusive, and diversity is going to be claimed, then we need to account for everyone's way of learning. We don't all learn the same.

6.3. Core Value: We Are Committed to Equity

The following in vivo statement exemplified the primary theme in the responses noting the equity core value: "the more we try to embrace analytics, the less we rely on our biased judgements." Example statements pertaining to this theme included the following:

> I think that I have reservations that we can inadvertently bias ourselves. But I think the more we can try to incorporate analytics and embrace that spirit, the less we rely on some of our instinctive judgments, which you know, are inherently biased. And maybe it's a better together kind of thing when you can combine your intuition and as much data as possible.
>
> I think it kind of holds the campus and the university accountable with the core values saying that they're committed to equity. Because analytics just make sure that we all have an equal chance and a fair chance at education and all that and it's just as reflected for the professors and whatnot. So the core values will hold us accountable.

6.4. Core Value: Innovation and Excellence Drive Us

The primary theme in the responses around innovation and excellence was as follows create an extra set of tools to support quality experiences. Examples of this theme included the following:

> Even though prescriptive analytics may not be a perfect tool, that doesn't mean it's not a tool that can't be used effectively. We just have to be very cognizant of how we're using it, and of the other variables that are at play, and of how we assess what we're doing. It's like everything in life, everything in education—you need to take a moment, step back and reassess if what you're doing is effective or not. So I think that does align with Bay Path's core values in that it's an innovation and excellence striving. We're always striving to be better. Even though our tools are imperfect, we're always striving for excellence.
>
> It's an extra set of tools for faculty and staff to use to support our learners and to support the experience, to support the quality of the courses that we're delivering. It's a consistent process, a consistent set of tools so that we're all working together. It's shared knowledge, hopefully, with the warehouse. So if we're working collaboratively, that data is available to multiple people. And I think about the recommendation for tutoring, or being able to provide automated support, or recommendations—that's in some ways the low hanging fruit and takes that off the plate of the faculty who can then also work on creating additional materials or reaching out to the student to meet via zoom or whatever they need to do.

6.5. Core Value: We Pledge to Foster Inclusion and Belonging

The primary theme in the responses pertaining to inclusion and belonging was as follows: validate students' inclusion and feeling understood in their learning experiences. Example participant quotes included the following: "You're considering that they need that to feel like they're belonging and they can do this".

> Fostering inclusion and belonging stands out. If there are students that are struggling in certain areas, we can find a way to make them feel more included, and feel more understood in their course, and give them whatever tools they need.

6.6. Core Value: We Work Best as a Community That Collaborates

The primary theme for the core value of collaboration was as follows: this work necessarily brings different voices together to discuss better supporting students. Examples of this theme included the following:

> I think of how, as I look at ways to utilize data, it requires collaboration in a lot of ways. So I'm reaching out to multiple staff and other stakeholders as we're considering what data to use and how to use it, and how it can provide benefit as we work together in figuring out those things. That makes it more effective. That makes it better. I don't know if we're doing it right. We're hitting on that core principle of collaboration and we're again making things better for our students, for the university, for the community, for faculty, etc.
>
> I think that it's easy for everyone to get in their lane and do their own thing and their specialty. And it's always so refreshing and exciting to talk to people in departments who don't typically get to talk and see all the wonderful ideas and that different perspective that is so illuminating. But also it's just kind of shocking sometimes when you realize that I've been looking, you know, at this in such a limited way and I think that I'm seeing all sides of it and I'm not even close.
>
> There's just no way one person can do or make use of such immense and intricate data. So, there's the people that are tasked with collecting it, and the people who analyze it, and the people who use it, and so forth.

6.7. Core Value: We Treat Others with Respect and Compassion

The primary theme in the responses for respect and compassion was as follows: hold students' experiences with respect to help them navigate their education and get help when needed. Examples of this theme included the following:

> What's been said drives them to the core value of we treat others with respect and compassion. What I'm learning from the course I am teaching right now and students who have shared personal experiences with me is that depending on upbringing, culture, family background, etc., some students can't ask for help. Or if they do, it's a sign of weakness in certain cultures. I think we have to understand that and respect that. Instead of saying, Oh, this student's just lazy, they may be so overwhelmed that they don't ask questions.
>
> This had a direct response from another participant who said, "I like what the last speaker said about backgrounds because we also have a lot of veterans here and the military teaches: do not ask for help. It's a weakness".
>
> Treating with respect and compassion stands out to me, because this is all about making Bay Path's classes, both online and traditional, more easily navigated by the students, and just better in the institution, and also the way in which we learn. I think it's going to lead to a better outcome overall, and I think that's very compassionate.

6.8. Core Value: Health and Well-Being Matter

The primary theme around health and well-being was as follows: engage a mindset that reduces student anxiety, stress, and doubt. Examples of this theme from the participants included the following:

> So the whole health and well-being thing, I think, if we can look at the data and analytics and help our learners learn better—I think I see a lot of anxiety and a lot of stress when it comes to especially around exams and stuff. So I think if we can help them learn better, we can help them get tutoring. Or I think by just focusing on that first bullet point [i.e., our learners come first] will help improve the last bullet point [i.e., health and well-being matter], because it will help them not be as stressed. It'll help them be not so anxious, you know. So I think it'll tie into how to have a more positive mindset. And to be, I got this, instead of going into something like a ball of nerves. So I think those two are hugely tied together. So I think by fixing one, you can help improve the other.
>
> Which also goes with the health and well-being because they're stressed out or kind of doubting themselves. Like, self-esteem, and so forth. But I think all of this, this whole idea could actually touch base on all of the core values. . . . It could help improve the health and well-being aspects because if you're able to find ways to try to strategize on the academic levels and find out, you know, well, why are they needing a tutor? What aren't they being given by the instructors? Or what's not said? What is being said? In the end, after you figure all that out, because at that time, the student is stressed, they're having anxiety. Sometimes it can fall into depression if it goes far enough. But their self-worth is extremely important. And I think it would all start if your ideas press through and find ways to combat it.
>
> I know personally, health and well-being, they are very important things to me. I spend most of my time doing schoolwork, and I know that's expected, this is college, but over 20 h a week. And being able to figure out a way, even if it's not the data that's coming from me, getting data and figuring out a way to better, more efficiently manage how we study, and the strategies that are going to make this more efficient I think are going to, at least for me, immensely improve my health and well-being while attending college. Just over the amount of time and effort that gets put in, I think it's going to be helpful.

7. Discussion

Across the focus groups, some participants discussed how they saw each core value supported by the proposed analytics initiative, leading to the identification of cross-cutting

core relevance as a key finding. Most participants identified one, two, or a few core values they thought were exemplified by the proposed project. Some participants felt the project related to all core values clearly. However, a few participants expressed skepticism, leading to the key finding of the importance of multiple perspectives. Participants did not agree on which core values were most aligned or whether some were aligned, which should be considered when interpreting the results. This lack of consensus reinforces the emergent nature of such an initiative and the need for strong stakeholder involvement throughout any implementation initiative, as suggested by the OrLA framework [1]. However, although skeptics existed, they were a small minority. The voices speaking about how the project would enact and reinforce core values were, on balance, much stronger than feelings and opinions questioning the connection.

Within the set of core values, themes that most prevalently arose included the following: (a) help students by making currently invisible patterns visible; (b) diversity should be reflected throughout; (c) "the more we try to embrace analytics, the less we rely on our biased judgements"; (d) create an extra set of tools to support quality experiences; (e) validate students' inclusion and feeling understood in their learning experiences; (f) hold students' experiences with respect to help them navigate their education and get help when needed; and (g) engage a mindset that reduces student anxiety, stress, and doubt (see Figure 1). These findings provide important results that can be guideposts to this institution when proceeding with this initiative. Findings may also be beneficial for other institutions contemplating similar analytics initiatives, particularly when considering organizational context [20]. Aligning such initiatives with institutional values can direct available resources toward valued online support.

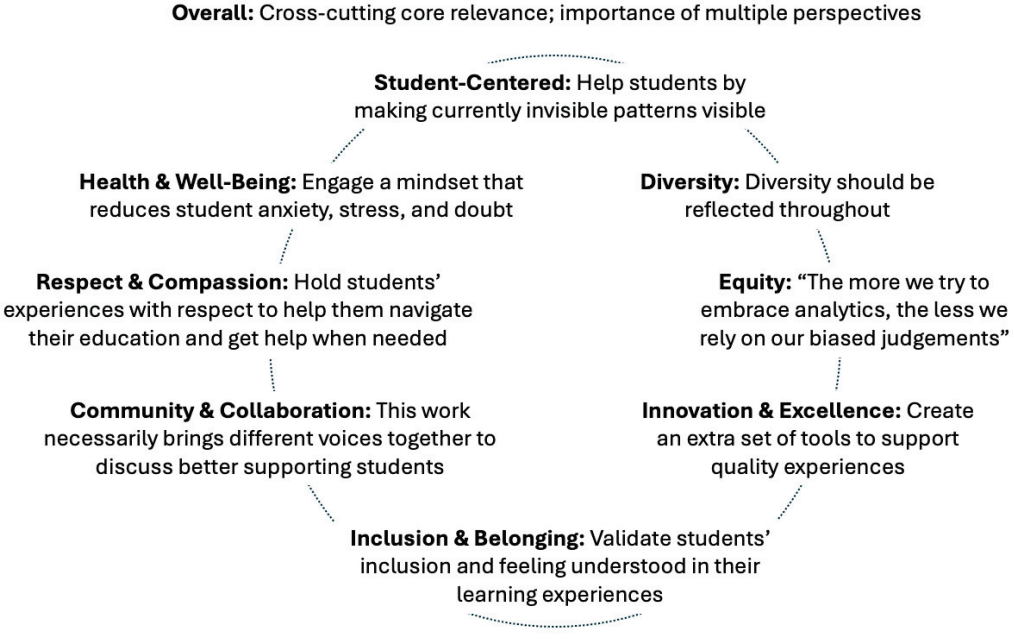

Figure 1. Key themes.

Of these themes, the most interesting and surprising result was the finding around "health and well-being matter". Students, rather than faculty or staff, were the ones who emphasized this. They saw it as an important core value relating to the potential for a prescriptive analytics initiative to support students by bolstering their self-worth. These students keenly recognized the anxiety and stress many current students face, connecting

the potential for decreased anxiety to getting directed to tutoring at opportune moments when stress would otherwise be high due to confusion about course material. Multiple students across different focus groups saw such a connection between the use of data to provide timely support recommendations for students through prescriptive analytics and health and well-being, including mental health. Students sought the efficiency of support that analytics has the potential to provide, particularly for busy students juggling multiple responsibilities including work, school, and home life. The idea that these students think prescriptive analytics can help them feel "I got this" at times when they would otherwise be "a ball of nerves" is a powerful testament to the humanistic side of data-informed decision making and a compelling argument for the value of such an initiative, particularly after the impacts of the COVID-19 pandemic for higher education [29]. This finding illustrates the importance of including a wide range of stakeholders in discussions of analytics project directions, and particularly making sure students are involved, in line with the OrLA framework's recommendations [1].

Notably when interpreting these findings, the institutional process that identified a common set of core values should be recognized as a key feature facilitating this study. The potentially amorphous nature of shared values among a group as large as an institution could challenge those wishing to have such discussions on their campus. Although mission and vision statements could be starting places for such discussion [30], these differ from statements of values [10]. All participants knew these institutional values, so they acted as a shared reference point for discussing values about the present project. This awareness reduced the amount of preparatory time needed for a productive group conversation about values because the set of potential values was finite and known.

8. Conclusions

These results demonstrate that people from across the campus involved with both online learning and campus-based learning see promise for improving student academic support through the strategic use of online technology that would deliver learning analytics-based recommendations to students about possible tutoring. Such forward-thinking prescriptive application using the increasing amount of data available for analysis in service of targeted student support aligns clearly with each of this institution's core values [10]. Despite the lack of consensus for the relevance of each core value, institutional stakeholders felt strongly that each value could be obviously aligned. This offers hope that such application of online technology could help the institution affordably improve its instruction by utilizing extensions to existing strategic investments. This could provide more efficient and effective support to both traditional and non-traditional students.

This study reinforces the importance of stakeholder engagement in the design process of analytics initiatives. Specifically, this study explored the alignment between institutional and stakeholder values and the perceived value proposition of an analytics initiative. This study extends prior participatory design work by making discussions of values explicit rather than hidden [4]. Results also emphasize the importance of having early involvement of groups who will contribute to the design phase of the implementation. The lack of consensus about the alignment with the institutional core values demonstrates the relative newness of analytics in higher education and the need to continue exploring of the value of data to inform decisions [3]. The need for ongoing stakeholder involvement exists even at an institution that (a) espouses the value of data-informed decision making, (b) seeks out ways to implement this approach, and (c) has successfully done so in the past, including with displays of institutional data using PowerBI and using analytics in the learning management system and the adaptive learning system [7]. By pursuing this action research in collaboration with faculty, staff, and students, this project contributes to understanding contextual factors facilitating co-designing a prescriptive analytics system.

These results will be summarized for the university's administration in a feasibility report along with the results of the second round of focus groups centered on the resources and processes necessary to implement this prescriptive analytics initiative. The report will

highlight the themes that emerged and participant voices that exemplify them. The lack of unanimity of thinking provides a cautionary note not to be overly prescriptive in the approach itself.

Future administrators, data analysts, and researchers should aim to align analytics initiatives with the values espoused by the institution and its stakeholders. This alignment could be through explicit values statements, as collectively crafted at the current institution studied, or potentially as stated in or derived from the institutional mission and vision statements. The efficacy of this latter option would need to be explored in future research. The current findings support the argument that success of implementing prescriptive analytics will likely be strengthened by such organizational contextual alignment [20]. Other learning analytics applications may be similarly strengthened by connecting to shared values, as there was little in the focus group discussions unique to a prescriptive prediction approach compared with other forms of predictive analytics.

Overall, alignment between an institution's core values and implementation of prescriptive analytics as seen in the present research, when achieved, means resources devoted to the analytics initiative will be more clearly targeted toward areas of importance to the institutional community. Academic leaders championing a prescriptive analytics initiative could expect values alignment to increase the likelihood of adoption and, therefore, the project's usefulness, along with the long-term relevance and sustainability of such an approach.

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Article

The Future of Postsecondary Education in the Age of AI

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Abstract: This paper examines a *possible future* for postsecondary education in the age of AI. The consensus view among economists is that AI is a general purpose technology (GPT), similar to the steam engine, electricity, and the internet. As a GPT, AI will be the main driver of innovation for the foreseeable future in most sectors of the economy, including education. As AI evolves, it holds the promise of fundamentally redefining the educational landscape, influencing not only current practices in institutional management and pedagogy but also shaping future trends in learning, evaluation, and accreditation. While traditional college-aged students have received significant attention in educational studies, this paper emphasizes the needs of *adult learners* as *lifelong learners* and explores how *AI-driven innovations* can enhance their educational experiences, offering personalized and flexible learning solutions. This paper also argues that a dramatic breakthrough is needed in the *cost–value equation* for education to support workforce development and lifelong learning.

Keywords: artificial intelligence; adult learners; adaptive learning; generative AI; learning analytics

1. Introduction

Creating an educated workforce is a global challenge. According to a recent study of the US economy by *Georgetown University's McCourt School of Public Policy Center on Education and the Workforce*,

> "Postsecondary education is no longer just the preferred pathway to middle-class jobs—it is, increasingly, the only pathway". [1]

The report goes on to note that the workforce is rapidly upskilling and 72% of all jobs by 2031 will require workers to have at least some postsecondary credential or training beyond high school, see Figure 1.

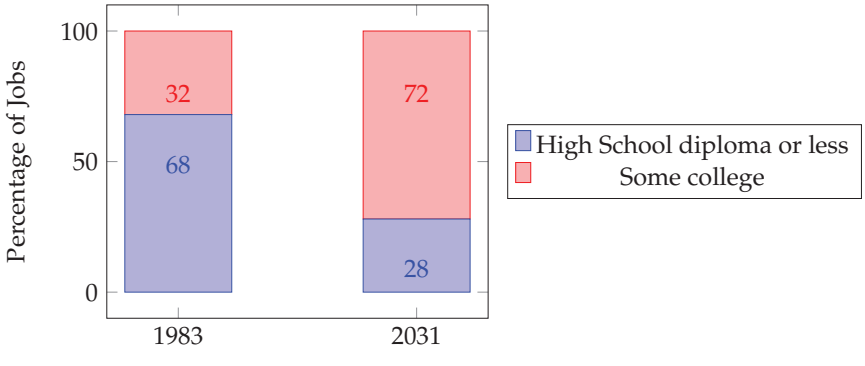

Figure 1. In 1983, 32% of jobs required some college. By 2031, the number is projected to increase to 72%. Source: Georgetown University Center on Education and the Workforce.

The shift in demand for highly skilled workers coincides with rising inequality. The gap is widening at an alarming rate with economies increasingly dominated by a

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"winner-takes-all" scenario, where a mere 1% of the population controls the vast majority of wealth, power, and freedom [2–4]. A revitalized approach to education, therefore, holds the key not only to meeting workforce needs but reversing the trend of inequality.

It is apparent that the supply of affordable and effective learning has not kept pace with demand. The problem is especially acute for adult learners and their need for lifelong learning. The market reasons for the mismatch are complex. However, several things are clear. First, incentives and institutions are aligned to meet the needs of traditional learners taking traditional courses in traditional disciplines. Second, a "known known" in learning science is that we "learn by doing, not viewing" [5]; yet most instruction, including in complex subjects, encourages passivity: listening to lectures, watching videos, and reading textbooks. Third, middlemen in the education value chain (e.g., publishers and edtech) contribute to rising costs but have failed to adapt to new market needs and opportunities [6,7].

Can **AI** be a force of *creative destruction* [8] in education?

This paper is divided into four sections. First, I begin with a problem statement defining some key *educational challenges*. The problem statement also sets the stage for examining how AI can help to solve these challenges. Second, I discuss why AI is important. AI is not a run-of-the-mill technology but what economists call a general purpose technology (GPT). GPTs historically are the hallmark of creative destruction across the entire economy. Third, I examine the practical economics of lifelong learning. I pose the following question: *Is lifelong learning currently affordable to those who need it most?* Finally, I outline how AI can address the key educational challenges laid out in the first section. I do so by outlining a new open-source project, created by the author, called **AI-Learn**.

Having outlined the broad challenges and opportunities presented by AI in postsecondary education, let us delve into specific problems this technology can address.

2. Problem Statement

I define some key *educational challenges* faced by all learners but particularly adult learners in the modern economy. The problem statement is in the form of four premises:

1. Students are not taught what they need to learn.
2. Students do not learn what they are taught.
3. Students need to learn throughout their lives, and what they need to learn changes frequently.
4. Practical knowledge in STEM disciplines is increasingly inter-disciplinary, computational, and data-intensive.

2.1. Students Are Not Taught What They Need to Learn

Given the dynamic nature of the modern economy, there is an increasing divergence between *what students need to learn* and *what they are taught*.

We can visualize this with a simple Venn Diagram as shown in Figure 2.

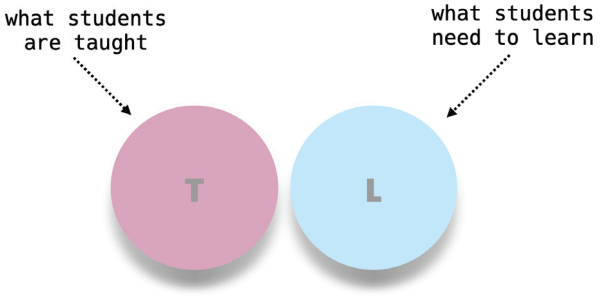

Figure 2. Circle T represents what students are taught. Circle L represents what students need to learn.

The target of good learning design is to achieve a strong overlap between the two circles (Figure 3).

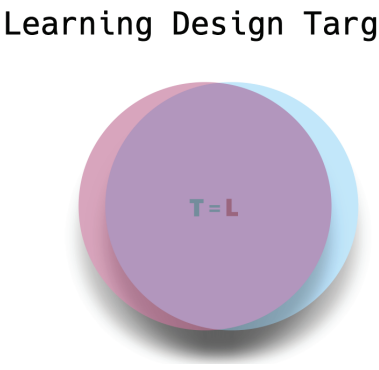

Figure 3. In the target case, there is strong overlap between what is taught and what students learn, represented as **T = L**.

But we need to anticipate a misalignment between what is taught and what students learn. There are two primary reasons for the divergence. The first is due to poor learning design. The second is due to shifts in the knowledge domain. In the divergent case, the areas of *non-overlap* can be become sizable. We should note that there are two distinct areas of non-overlap (Figure 4).

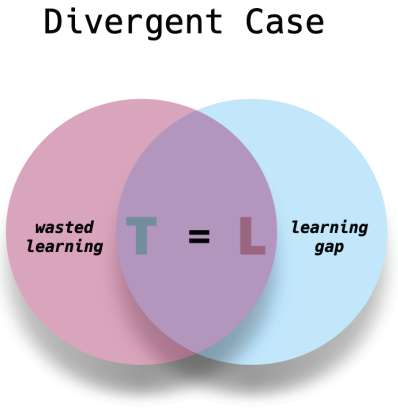

Figure 4. The first area of divergence represents the *skills gap* (what is not taught but students need to learn) and the second represents *wasted effort* (what is taught but students do not need to learn).

Both areas translate as a *cost* to the student. The skills gap means that the student has to bridge the gap elsewhere, needing more time, money, and effort. Wasted learning means that the student has squandered time, money, and effort. Wasted learning is an irrecoverable cost. Taken together, the real cost is what economists call the *opportunity cost*: the value of the next best alternative that an individual foregoes in order to pursue a certain action or decision.

This paper's key argument is that for adult learners, the opportunity cost of education is now prohibitively high due to new market realities; however, AI has the potential to significantly lower these costs.

2.2. Students Do Not Learn What They Are Taught

Even in the case where students are taught what they need to learn (the area of overlap **T = L**), students do not necessarily learn it. Instructors believe they have taught what students need to learn. Students believe they have learned what instructors have taught. Instruction can be *ineffective* even when the right subject matter is taught and students make an effort to learn it. This is the *problem of inefficacy* and it manifests itself in the curriculum and teaching practices in several ways.

First, a bedrock principle of learning science, confirmed by an overwhelming number of studies, states that we learn by doing, not by viewing [5]. Yet most instructors remain wedded to the lecture format. The situation is no better online. In online environments, video lectures are often substituted for live lectures. We have simply replaced one form of passive learning with another. Similarly, instructors assign reading material from a textbook. Students read it. Both believe learning has magically occurred. But this is a mirage.

Second, traditional instruction does not take into account the fact that each learner comes to learning with different prior preparation. Those with weaker preparation begin with a handicap. In a course where everyone has the same amount of time to master the material, those who start behind must learn the material at a faster pace than those who are adequately prepared. As the course progresses, if the handicap is not addressed, small "errors" or gaps compound quickly and become irrevocable [9]. It has been shown formally that learners on their own, no matter the amount of "grit" or "mindset", cannot close the deficit if the learning environment is not supportive [10].

Third, much of learning requires relearning. It takes repeated practice to make knowledge stick, to move it from working memory to long term memory. And it takes spaced practice and reinforcement to keep the knowledge usable [11]. Traditional instruction is based on the mistaken assumption of "teach once, learn once, and we are done". Relearning also needs to take place not just in a course but across courses in a discipline. But given the fragmentary nature of course design at most institutions, students move on to advanced courses not having adequately learned materials from previous courses.

Fourth, traditional learning does not take into account the fact that different parts of knowledge serve different roles [12]. Much like a well-constructed building, each part plays a special role and the entire edifice must be constructed harmoniously. A building requires a solid foundation. Yet most learning design ignores the special role of foundational knowledge or underestimates its importance in sustained and successful learning.

2.3. Students Need to Learn throughout Their Lives and What They Need to Learn Changes Frequently

Traditional education is based on an outdated linear pattern: we are born, go to school, work, raise a family, retire, and then we die. Modern society, and the economic life on which it rests, no longer fits this pattern. In order to survive and thrive, we now need to learn and update our skills throughout our life. As new technologies and economies emerge, what we need to learn also changes frequently.

We have already cited the study by Georgetown University's Center on Education and the Workforce, which indicates that "by 2031, 72 percent of all jobs will require workers to have at least some postsecondary credential or training beyond high school" [1]. In one of the newest global surveys on reskilling, McKinsey notes that "the need to address skill gaps is more urgent than ever. A majority of respondents (58 percent) say that closing skills gaps in their companies' workforces has become a higher priority since the pandemic began". The results also suggest that "this commitment to skill building represents more than a one-time investment". For most companies, closing "skill gaps were a pressing and critical issue".

Some have raised the specter of AI replacing humans. But a more likely scenario is one where specific tasks will be automated by AI, not the wholesale automation of entire jobs. This means that in order to become more productive and competitive in the marketplace,

workers will have to learn to perform new tasks, tasks which are out of reach of automation and AI.

The rapidly evolving job market, propelled by advancements in artificial intelligence and automation, demands a shift from traditional education models to continuous learning pathways. To remain relevant and competitive, individuals must engage in lifelong learning that is adaptive and responsive to changing industry needs. The integration of AI-driven platforms can facilitate personalized learning experiences, offering courses and materials that evolve in real time with job market trends. This ensures that learners are always equipped with the most current skills and knowledge, bridging the gap between education and employment requirements.

The future of lifelong learning is not just about individual upskilling but also about creating collaborative ecosystems where individuals, educators, industries, and AI technologies interact seamlessly. Such ecosystems would leverage AI to analyze learning outcomes and job market trends, recommending learning paths not just for individuals but also for communities, thereby fostering a culture of collective intelligence. By enabling shared learning experiences and insights, AI can help construct a more inclusive and efficient educational landscape that prepares all learners for the challenges and opportunities of the future workforce.

2.4. Practical Knowledge in STEM Disciplines Is Increasingly Inter-Disciplinary, Computational, and Data-Intensive

STEM disciplines are the driving force behind modern economies. However, the general public and policy makers' understanding of how these disciplines have evolved and operate has not kept pace. In many cases, academic practice also lags behind in how the disciplines are taught.

There have been three ***scientific paradigms*** and we are in the midst of a fourth [13,14]. The *first* scientific paradigm was largely *empirical*. Approximately a thousand years ago, humans began to systematically collect and record data to describe natural phenomena. The Mayans, for example, created detailed calendars for tracking astronomical phenomena, like solar and lunar eclipses, planetary movements, and solstices. The Qimin Yaoshu ("Essential Techniques for the Welfare of the People") is an extensive agricultural manual on agronomy, horticulture, afforestation, sericulture, animal husbandry, veterinary medicine, brewing, cooking, and storage, as well as remedies for barren land [15].

The *second* scientific paradigm, represented by *theoretical science*, emerged during the last few hundred years. The key breakthrough was the use of models to summarize, explain, and predict natural phenomenon. Notable examples include Kepler's Laws, Newton's Laws of Motion, Maxwell's equations, and Darwin's theory of natural selection.

The last few decades have seen the emergence of the *third* scientific paradigm. Its defining characteristic is *computation* and *simulations* to model natural phenomena. As theoretical models grew too complicated to solve analytically, scientists began to devise numerical solutions. Then, these numerical techniques were extended and applied to complex phenomena such as weather patterns through the use of simulations. Simulations have become powerful instruments for modeling complex phenomena, but they also allow us to investigate multiple alternative possibilities and how each one might play out in the natural world.

In recent years, even before the explosion of artificial intelligence, we have reached a fourth scientific paradigm. Jim Gray, the Turing Award Winner, labeled this fourth paradigm "eScience". Its hallmark is the data-intensive unification of theory, experiment, and simulation.

> The techniques and technologies for such data-intensive science are so different that it is worth distinguishing data-intensive science from computational science as a new, fourth paradigm for scientific exploration. . .
>
> If you look at ecology, there is now both computational ecology, which is to do with simulating ecologies, and eco-informatics, which is to do with collecting and analyzing ecological information. Similarly, there is bioinformatics, which

collects and analyzes information from many different experiments, and there is computational biology, which simulates how biological systems work and the metabolic pathways or the behavior of a cell or the way a protein is built [14].

AI has accelerated eScience as the *fourth paradigm* of scientific discovery and invention. It unifies theory, experiment, and simulation with data-intensive computation. Among practitioners, the fourth paradigm requires inter-disciplinary knowledge (e.g., domain knowledge, statistics, programming, data analysis, and visualization) along with a thorough understanding of the scientific method.

Understanding these educational challenges sets the stage for exploring how AI, as a transformative general purpose technology, can be leveraged to address them.

3. Why Is AI Important?

Let us turn now to AI to better understand how it is emerging as the driving force of the new economy. The consensus view among economists is that AI is a "general purpose technology" (GPT). The GPT here is not the "GPT" of "ChatGPT", which stands for "Generative Pre-trained Transformer". What economists really mean by GPT is a "Technology with Superpowers".

GPT is a technology with Superpowers.

GPTs are rare, and when they come on the scene, they cause significant, widespread impacts across an economy, affecting multiple industries and sectors. GPTs are not innovations that improve efficiency or effectiveness in a specific area; rather, they are *foundational technologies* that transform economies and societies at scale. Historical examples of GPTs include the steam engine, electricity, and the internet. For better or worse, we are now in the **Age of AI** as a GPT.

GPTs have three salient characteristics: *pervasiveness*, *accelerating improvements over time*, and the capacity to drive *complementary innovations* across industries [16]. Let us take a look at each characteristic with the example of electricity.

1. ***Pervasiveness*** refers to the wide-ranging applicability and use of a technology across various sectors and industries. Electricity revolutionized multiple industries and aspects of daily life starting in the 1880s. It quickly became an essential part of residential, commercial, and industrial settings. From lighting homes to powering factories, electricity's ubiquitous presence transformed the way society functioned. It facilitated the transition from manual labor to mechanized processes, impacting everything from manufacturing to transportation and even the nature of household chores. The key period for its development and widespread adoption was primarily between the 1880s and the early 1920s.
   In 1882, Thomas Edison opened the Pearl Street Station in New York City, the first commercial central power plant in the United States. Soon after, the widespread installation of electrical lighting in urban areas began, gradually replacing gas lighting. This period also saw significant advancements in electrical engineering and the development of alternating current (AC) systems, which were more efficient for long-distance power transmission than the direct current (DC) systems initially used. In the early part of the 20th century, electrification started to spread beyond lighting, powering industrial motors and public transportation systems (like electric streetcars) and leading to the development of a variety of electric appliances for homes and businesses. By the 1920s, electricity had become a critical infrastructure in urban areas in the United States and Europe, signaling its status as a GPT.
2. A hallmark of GPTs is their potential for ***improvement over time***, becoming more efficient, powerful, and adaptable as the technology becomes pervasive. The evolution of electricity was marked by significant advancements in generation, distribution, and utilization. From the initial direct current (DC) systems to the more efficient alternating current (AC) systems, the technology of electricity generation and distribution underwent substantial improvements. Innovations like the transformer, the electric

motor, and the development of nationwide power grids massively enhanced the efficiency and reliability of electricity. Over time, these improvements expanded the scope and scale of electricity's applications, making it more versatile and efficient.

3. GPTs also spur ***complementary innovation*** that cascades across multiple industries. GPTs spur the development of new industries, technologies, and processes that complement the GPT itself. The widespread adoption of electricity led to the creation of entirely new industries and technological innovations. The electric light bulb, household appliances like refrigerators and washing machines, and, later, electronic devices like computers and telecommunications equipment are all examples of complementary innovations spurred by electricity. These inventions, in turn, created new markets, new forms of entertainment, and even new ways of working and living. The development of these complementary technologies further embedded electricity into the fabric of modern society, illustrating its role as a catalyst for broader economic and technological transformations.

Artificial Intelligence as a GPT

It is increasingly apparent that artificial intelligence is the modern embodiment of general purpose technology. It exhibits the three key characteristics that define GPTs.

1. AI's *pervasiveness* is evident in its widespread adoption across multiple domains. In healthcare, AI is now used for diagnostic procedures and personalized medicine. In finance, it powers algorithmic trading and fraud detection systems. In the automotive industry, AI is at the heart of self-driving car technology. It has also transformed consumer products through smart assistants, personalized recommendations in retail and entertainment, and more. This broad spectrum of applications across varied fields underlines AI's pervasive nature.
2. AI has seen *significant improvements over time*, especially in machine learning algorithms and neural network designs. The evolution from simple decision trees to complex deep learning models and the development of neural networks capable of processing vast amounts of unstructured data are prime examples. Each iteration brings more sophisticated, accurate, and efficient AI capabilities. The rapid advancements in AI's learning algorithms and processing power showcase its ongoing improvement and expanding potential.
3. AI has spurred a multitude of *complementary innovations* across various sectors. In the field of robotics, AI has enabled the creation of more autonomous and intelligent machines. In the realm of data analytics, AI's ability to process and interpret large datasets has led to significant advancements. AI has also fostered innovations in fields like energy management (smart grids), education (adaptive learning platforms), and even creative industries (AI in art and music composition). These innovations not only leverage AI technology but also expand its application and utility, demonstrating its role as a catalyst for further technological and industrial advancements.

4. Practical Economics of Lifelong Learning

Having established AI's pivotal role, we now turn to examine its impact on the practical economics of lifelong learning and its accessibility. Let us pose a practical economics question:

Is lifelong learning affordable to those who need it most?

In the modern economy ruled by AI, lifelong learning is not a luxury but a necessity. Can those who need it most afford it?

To answer the question, let us begin by looking at US household income by quintiles. As of 2024, the US population is approximately 335 million. There are approximately 126 million households, with approximately 2.7 persons per household. Figure 5 shows the mean income (in USD) by household quintiles.

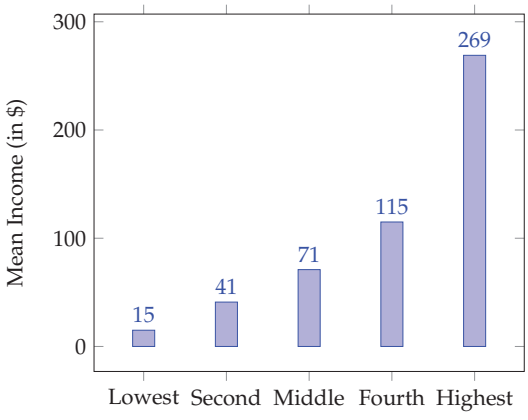

Figure 5. US household mean income by quintile.

The same data are shown in tabular format in Table 1.

Table 1. US household mean income by quintile.

Quintile	Mean Income (USD K)
Lowest	15
Second	41
Middle	71
Fourth	115
Fifth	269

Next, let us estimate living expenses for a household in a city where the cost of living is neither too high or too low (e.g., Minneapolis, MN, USA). Table 2 shows living expenses for an average household with one child.

Table 2. Living expenses for an average household (2 adults, 1 child) in an average city. Source: MIT Living Wage Calculator (http://livingwage.mit.edu (accessed on 8 January 2024)).

Category	Amount
Food	9159
Child care	10,401
Medical	8332
Housing	11,780
Civic	6565
Other	9905
Annual taxes	12,908
Required annual income before taxes	85,101

If we compare living expenses with income quintile groups, our simple estimate, based on a conservative calculation, illustrates that lifelong learning is likely to be out of reach for the majority of households.

5. AI-Learn

With the groundwork laid for understanding AI's role in education and the economic considerations of lifelong learning, we now introduce **AI-Learn** as a potential solution. The current educational system faces several challenges in delivering affordable, accessible, and quality skills-based training to a diverse range of learners. These challenges include the following:

- **High development costs**: Traditional curriculum development is labor-intensive and costly, limiting access to high-quality educational resources for institutions with limited budgets and, ultimately, their learners. We have seen through our quick estimate that unless there are significant breakthroughs in curriculum development, lifelong learning will be out of reach for those who need it most.
- **Inefficient processes and untimely content**: Conventional methods for creating and updating curriculums are time-consuming and often struggle to keep pace with the rapidly evolving job market and technological advancements. We have this in the potential mismatch between what students need to learn and what they are taught.
- **Lack of personalization**: One-size-fits-all educational approaches often fail to address the unique learning needs of individuals, particularly those from historically marginalized communities, leading to suboptimal learning outcomes.
- **Limited collaboration**: Inefficient knowledge sharing and collaboration among educators, researchers, and institutions hinder the exchange of best practices, stifling innovation and progress in curriculum development.

If every citizen is to have access to affordable, high-quality education, then the cost–value equation needs to change dramatically. Although a number of factors make up cost and value, we can isolate two important variables where AI can potentially contribute to a breakthrough in the near term. Our goal should be to reduce the *cost* of education by at least a factor of 10 while enhancing educational outcomes or *efficacy*, including those from historically marginalized communities, with a minimum of a 0.5 effect size (Figure 6).

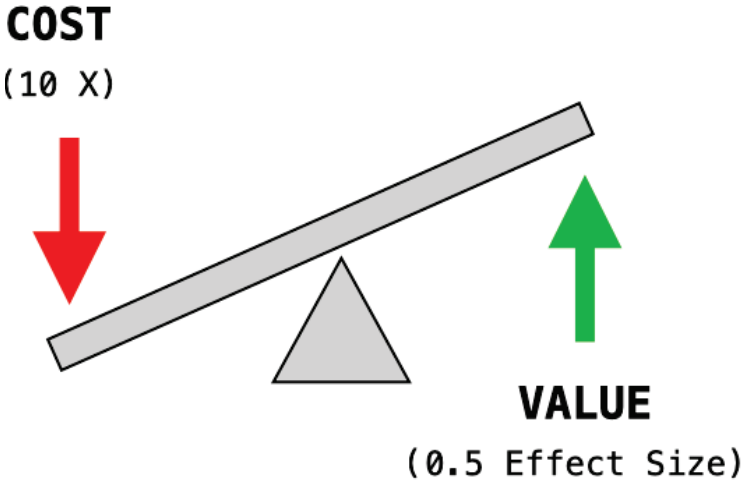

Figure 6. Cost–value equation for education.

In this section, we outline **AI-Learn**, an open-source project, which aims to do just this using AI. We offer **AI-Learn** as an example of the types of solutions that need to emerge in the marketplace if we are to make substantial progress in lowering the cost of education and increasing learning outcomes (Figure 7).

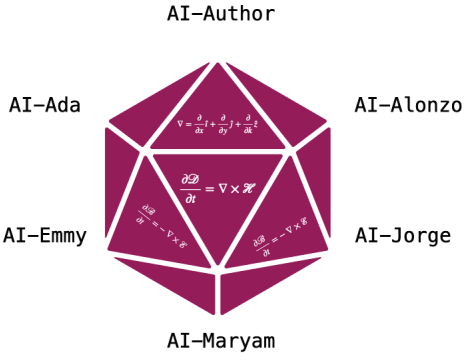

Figure 7. ALA platform components.

5.1. AI-Learn Components

The open-source AI-Learn platform consists of six major components:

- **AI-Learn Author** is an authoring wizard and design canvas for creating a skills-based curriculum.
- **AI-Learn Ada** is an AI-based extraction engine for automatically generating a recommended curriculum based on topics.
- **AI-Learn Alonzo** is an AI-based analytics engine for generating advanced insights and evaluating learning efficacy.
- **AI-Learn Emmy** is an AI-based intelligent tutoring system for delivering a personalized curriculum to each learner.
- **AI-Learn Jorge** is a "crowd-sourced" searchable digital repository of pre-configured curriculum materials with robust IP management.
- **AI-Learn Maryam** is AI-Learn's digital infrastructure, including cloud-based services for security, scalability, and integration.

Each component of AI-Learn plays a unique role in transforming educational delivery, as we will further explore in the subsequent section on pedagogical design. We describe each of these components and their role in the section on workflow. Prior to that, we review the pedagogical design of AI-Learn based on aligned learned activities or ALAs.

5.2. Pedagogical Design: Aligned Learning Activities

The cornerstone of AI-Learn's pedagogical design is smart, learning atoms called aligned learning activities (ALAs). An ALA is an aligned semantic triple consisting of (a) a learning objective, (b) assessments, and (c) learning activities. The assessments and learning activities are aligned to a particular learning objective (Figure 8).

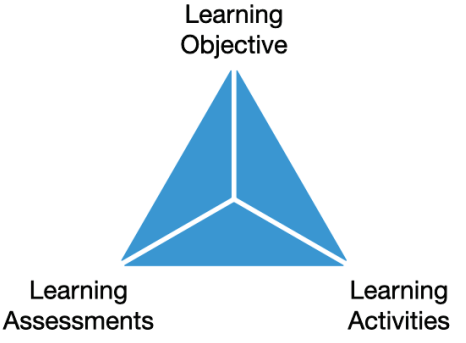

Figure 8. AI-Learn's pedagogical design is based on aligned learning activities (ALAs).

Traditional learning design is based on a "forward design" process. Instructors typically begin with learning materials such as a textbook, develop assessments (primarily quizzes and test), and then eventually get around to learning goals (Figure 9).

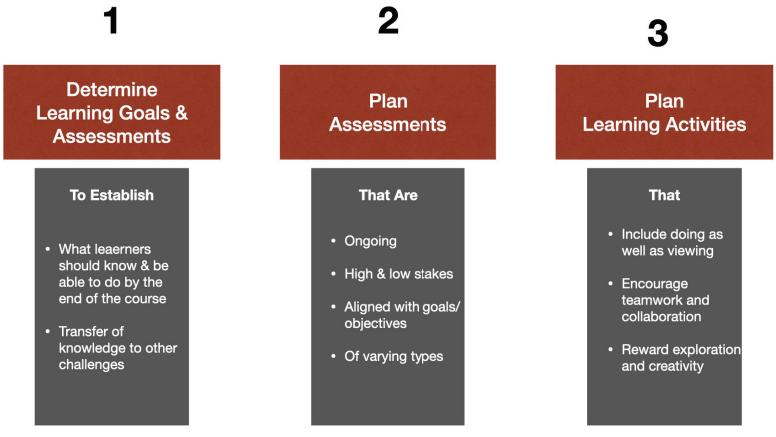

Figure 9. AI-Learn's backward design process.

The research evidence strongly suggests that learning outcomes can be improved by a backward design process [17]. In backward design, learning objectives are formulated first. A learning objective states the knowledge or skill a student is expected to master. The second stage defines the evidence, in the form of assessments, that will be used to know whether a student has achieved a learning objective and to what degree. The assessments are ongoing and primarily formative. Unlike quizzes and tests, formative assessments are designed to provide actionable feedback to both the learner and the instructor. In backward design, the instructional activities and learning materials are formulated last. The final stage defines how students are expected to master a learning objective. Students learn by doing, not viewing. Learning activities should go beyond passive learning (e.g., reading a textbook and watching a video) to include active and collaborative learning (e.g., solving problems and peer learning). In short, an aligned learning activity (ALA) captures the backward design process as a modular learning atom.

5.3. Workflow

Now that we have a preliminary understanding of AI-Learn's components and pedagogical design, let us examine its workflow to understand how these elements come together in practice. How does AI-Learn work? The AI-Learn tool and platform can be used to design, deploy, evaluate, improve, and share a skills-based learning curriculum (Figure 10).

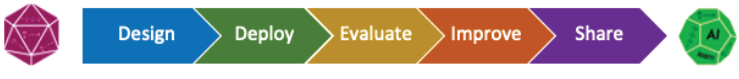

Figure 10. AI-Learn workflow.

To develop a skills-based curriculum, an educator begins with the **AI-Author** workbench and design wizard. AI-Author is a versatile design workbench that streamlines the curriculum creation process. With AI-Author, educators can harness AI-Learn's Large Language Models (LLMs) to automatically generate learning modules or full curriculums based on simple prompts. The platform allows for seamless editing, deployment, assessment, improvement, and sharing of Aligned Learning Activities (ALAs), fostering a dynamic and effective educational ecosystem (Figure 11).

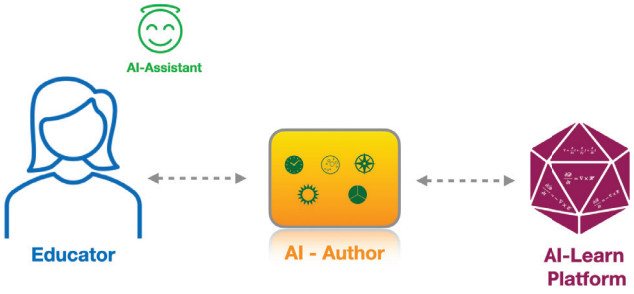

Figure 11. AI-Author workbench.

5.3.1. Extract Mode

The AI-Learn workflow begins with the *extract mode*, where an educator *automatically* generates a curriculum by issuing a series of guided prompts. AI-Learn then automatically generates the curriculum in the form of an ALA. The work of extraction is performed behind the scenes by AI-Ada, an AI engine based on Large Language Models (LLMs). The extracted curriculum is populated in the design canvas for review and editing. AI-Learn can automatically extract 50–75% of the curriculum for most STEM fields without prior training. AI-Learn can also extract ALAs from proprietary digital materials or Open Educational Resources (OERs) with additional modest training (Figure 12).

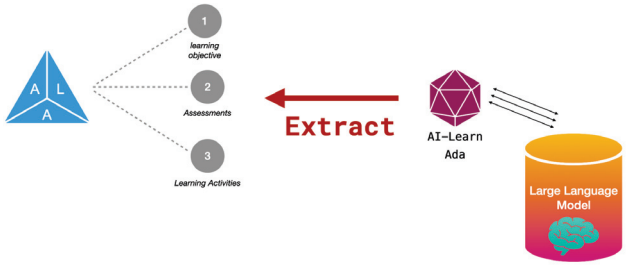

Figure 12. Extract mode.

5.3.2. Edit Mode

In *edit mode*, an educator uses AI-Author to edit and modify the curriculum elements generated in extract mode by the Large Language Model. Although AI-Learn automates much of the tedium of creating a skills-based curriculum, it is not meant to replace the domain expert or learning designers. It is meant to support and enhance their work (Figure 13).

Figure 13. Edit mode.

5.3.3. Discover Mode

In discover mode, an educator performs advanced search and discovery against a digital repository https://ailearncloud.github.io/ailearnweb/jorge.html#page-jorge (accessed on 8 January 2024)—AI-Jorge. AI-Jorge contains pre-configured ALAs contributed by the educational community and curated by domain experts. The discovered ALAs are populated in the design canvas for review and editing (Figure 14).

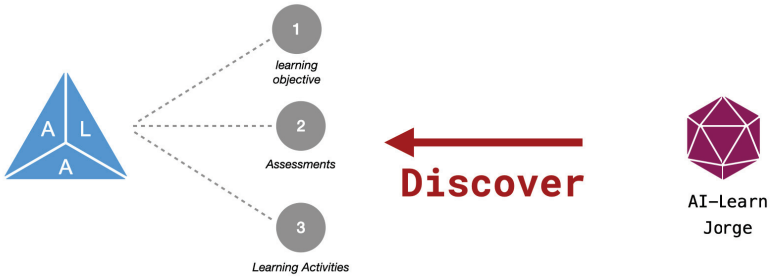

Figure 14. Discover mode.

5.3.4. Deploy Mode

In deploy mode, an educator deploys ALAs to intelligent tutoring systems and learning management systems using standard protocols, such as 1EDTECH's https://www.imsglobal.org/activity/learning-tools-interoperability (accessed on 8 January 2024)—Learning Tools Interoperability (LTI). ALAs can also be deployed to https://ailearncloud.github.io/ailearnweb/emmy.html#page-emmy (accessed on 8 January 2024)—AI-Emmy, a next-generation intelligent tutoring system (Figure 15).

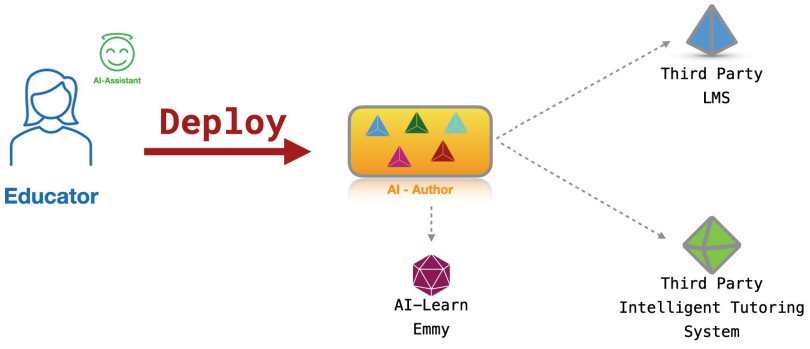

Figure 15. Deploy mode.

5.3.5. Evaluate and Improve Mode

In evaluate and improve mode, an educator evaluates ALAs using the AI-Learn analytics engine https://ailearncloud.github.io/ailearnweb/alonzo.html#page-alonzo (accessed on 8 January 2024)—AI-Alonzo. The analytics range from simple methods such as item analysis to propensity modeling and causal inferencing. AI-Alonzo can also generate recommendations for improving ALAs based on observational data. ALA "improvements" are recorded in a "scientific logbook" of modifications under the structure of hypothesis–experiment–data (Figure 16).

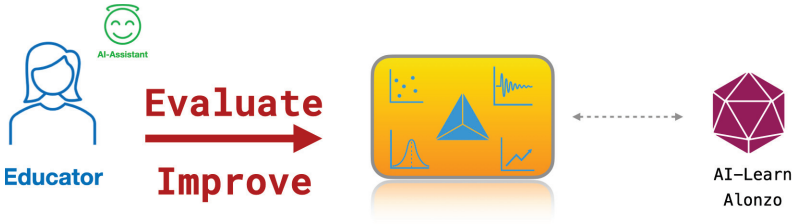

Figure 16. Evaluate and improve mode.

5.3.6. Share Mode

In share mode, an educator can share and license ALAs. AI-Jorge, therefore, is also a marketplace for exchanging ALAs based on license terms set by educators and institutions. Educators can also tag, rate, annotate, and recommend ALAs (Figure 17).

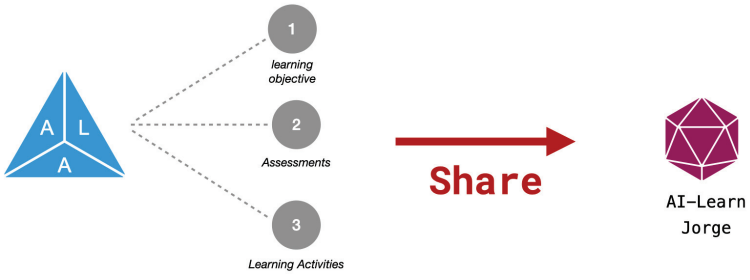

Figure 17. Share mode.

Drawing from the insights on AI-Learn and its potential impact on education, we conclude with reflections on the future of postsecondary education in the AI era.

6. Conclusions

In conclusion, this paper has underscored the transformative potential of artificial intelligence (AI) in redefining postsecondary education, with a particular focus on adult learners within the context of a rapidly changing economy. AI's capability to address the existing misalignment between educational offerings and the evolving demands of the workforce heralds a revolution not only in what we learn but also in how we learn. The advent of AI-Learn exemplifies a groundbreaking approach that utilizes AI to streamline curriculum development, personalize learning experiences, and deliver content more efficiently, representing a pivotal stride toward education that is more accessible, effective, and inclusive.

As we stand on the cusp of a new educational paradigm, propelled by AI's role as a general purpose technology, it is crucial for educators, policymakers, and technologists to engage in collaborative efforts to unlock its full potential. Such collaboration is essential to ensuring that education continues to serve as a potent instrument for personal growth and a vital asset for societal advancement. It is through harnessing the power of AI that we can bridge skill gaps and democratize access to knowledge, ultimately making learning a lifelong, equitable journey for individuals across the globe.

Looking ahead, the challenges and opportunities presented by AI in education demand a proactive and thoughtful approach. It is not merely about adopting new technologies but about reimagining the future of learning in a way that prioritizes ethical considerations, equity, and the human element. By doing so, we can pave the way for an educational system that not only prepares learners for the future but also shapes that future to be more inclusive, adaptive, and innovative.

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