Transformació Digital de l'Educació a l'Era de la Intel·ligència Artificial: Una Revolució Imparable

Cristina Valls Bautista
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Luis Marqués Molías
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EDUCATION IN POST-PANDEMIC CONTEXT: A CASE OF CENTRAL SWEDEN

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Abstract

The COVID-19 pandemic has profoundly impacted education, necessitating a rapid transition to remote learning and increased reliance on digital technologies. The purpose of this study is to explore students' perspectives on the quality of online learning compared to traditional face-to-face in a post-pandemic context. This is conducted through the effectiveness of online education and the motivation of the learners. The quantitative results through one-way ANOVA results show no significant difference in mean scores across courses or questions for online learning perceptions. Additionally, two-way ANOVA without replication revealed no significant difference in mean scores for both courses and questions. The qualitative results highlight the challenges of online education as Swedish educational institutions are urged to invest in technological infrastructure, faculty training, and student support services. The findings also reveal that while hybrid teaching is popular, creating an inclusive and engaging online environment is crucial for educational development. By understanding students' post-pandemic experiences, this research provides valuable insights to educators, enabling informed decision-making and improvements in pedagogical practices enhancing the quality of online education and fostering effective learning environments. This further can lead to advancements in the theoretical stances developing recommended teaching frameworks.

Resumen

La pandemia de COVID-19 ha impactado profundamente la educación, requiriendo una rápida transición hacia el aprendizaje remoto y una mayor dependencia de las tecnologías digitales. El propósito de este estudio es explorar las perspectivas de los estudiantes sobre la calidad del aprendizaje en línea en comparación con la enseñanza tradicional presencial en un contexto post-pandemia. Esto se lleva a cabo a través de la efectividad de la educación en línea y la motivación de los estudiantes. Los resultados cuantitativos mediante ANOVA de una vía no muestran diferencias significativas en las puntuaciones medias entre cursos o preguntas sobre las percepciones del aprendizaje en línea. Además, el ANOVA de dos vías sin replicación reveló que no hay diferencias significativas en las puntuaciones medias tanto para cursos como para preguntas. Los resultados cualitativos destacan los desafíos de la educación en línea, ya que las instituciones educativas suecas son instadas a invertir en infraestructura tecnológica, capacitación del profesorado y servicios de apoyo al estudiante. Los hallazgos también revelan que, aunque la enseñanza híbrida es popular, crear un entorno en línea inclusivo y atractivo es crucial para el desarrollo educativo. Al comprender las experiencias de los estudiantes post-pandemia, esta investigación proporciona valiosos conocimientos a los educadores, permitiéndoles tomar decisiones informadas y mejoras en las prácticas pedagógicas, mejorando la calidad de la educación en línea y fomentando entornos de aprendizaje efectivos. Esto además puede llevar a avances en las posturas teóricas desarrollando marcos de enseñanza recomendados.

Keywords

Online teaching, post-pandemic, student engagement, digital transformation

Palabras clave

Enseñanza en línea, post-pandemia, compromiso estudiantil, transformación digital

1. INTRODUCTION

The COVID-19 pandemic has compelled educational institutions worldwide to adopt modern teaching methods to ensure continued learning while mitigating the contagion's spread (Careaga-Butter et al., 2020; García-Morales et al., 2021). This shift led to a significant transformation in education delivery, with a notable emphasis on online learning supported by digital technologies (Munday, 2021). Educators quickly adapted by acquiring proficiency in online teaching tools, such as video conferencing and online platforms, to engage and motivate students in this new learning environment (Llerena-Izquierdo et al., 2020; Zizka & Probst, 2023). This adaptation has sparked

interest in assessing the effectiveness of online teaching and learning. In response to the challenges imposed by the pandemic, students have directed a shift to online learning, facing limitations in resources and support (Gacs et al., 2020) such as the absence of face-to-face interactions, affecting peer and teacher engagement, and restricted access to essential facilities like laboratories and libraries (Alam, 2022; Casacchia et al., 2021; Liang & Chen, 2012). While some students found online learning advantageous for self-paced education, others encountered difficulties maintaining motivation (Hromalik & Koszalka, 2018). The pandemic underscored the significance of technology in education (Ali, 2020) which in turn accelerated the development of online learning during temporary shutdowns and showcased the capability of digital technologies in facilitating online teaching and learning as noted by Kumar (2018). Thus, the implementation of digital technologies may have provided an expansion of lifelong learning for educators and students alike, despite time and place constructs allowing them to continue teaching and learning remotely (Ferri et al., 2020). Therefore, educational institutions invested in technology and infrastructure to support online learning, with some considering its permanent integration into curricula (Lynch, 2020). However, challenges persist highlighting the importance of face-to-face learning for the social intricacy of education despite the growing prevalence of online learning (Munday, 2021).

Previous research, such as Al-Kumaim et al. (2021), Alsolais et al. (2021), Munday (2021), Reid (2022), and Son et al. (2020) also emphasized the need for a renewed focus on students' mental health and wellbeing as the pandemic has created a challenging time for many students, and institutions will need to provide additional support to help them cope with the potential stress and anxiety that may have arisen during this time due to the limitations in resources and support (Gacs et al., 2020). Moreover, Munday (2021) further emphasized the importance of providing inclusive education that caters to the needs of diverse students. Therefore, the pandemic has further highlighted the inequalities in education, and to address these disparities, institutions should develop strategies to support and empower marginalized students (Winans-Solis, 2014).

1.1. Theoretical framework

1.1.1. The role of constructivism

The field of education continuously seeks innovative approaches to enhance meaningful learning experiences for students (Mohammed & Kinyó, 2020). One such approach that has gained significant attention and recognition is the student-centered approach which puts the student at the forefront of the learning process (Krahenbuhl, 2016; Munday, 2021). This approach further emphasizes that students ought to be active participants in their learning process, rather than passive recipients of information (Zizka & Probst, 2023). This aligns with the broader constructivist perspective rooted in the works of influential

psychologists like Piaget and Vygotsky (Hoidn & Reusser, 2020; Vasileva & Balyasnikova, 2019). Constructivism, emphasizing student-centered approaches and active participation, promotes meaningful interactions with the learning environment (Archambault et al., 2022; Suhendi et al., 2021; Vlachopoulos & Makri, 2019). While the continuous development in the digital transformation and the pandemic has promoted online learning it has consequentially propelled the prevalence of the student-centered approach (Abdullah Alkhabra, 2022; Alam, 2016; Munday, 2021). The role of constructivism in online learning, explores students' engagement with materials, collaboration with peers, and understanding of the subject matter, regardless of location and time (Abdullah Alkhabra, 2022; Alam, 2016). However, most studies of constructivism have focused on on-site learning (Calderón et al., 2021), leaving student-centered learning in an online context an unexplored area that may lead to improved academic performance, increased motivation, and higher levels of engagement (Alam, 2016).

Critics such as Ciampolini et al. (2019) and Al Mamun (2020) emphasize the perceived lack of structure and guidance in the learning process and argue that without clear instructional direction, learners may struggle to grasp essential concepts. Therefore, highlighting the importance of striking a balance between providing learners with autonomy and scaffolding their learning experiences (Drexler, 2010) which leads to educators needing to ensure that learners have access to appropriate resources, guidance, as well as support to go through complex tasks and construct more accurate understandings Christian et al. (2021). Seneviratne et al. (2019) emphasized the time-intensive nature of constructivist methods, particularly inquiry-based learning, involving an independent or guided investigation of complex questions and problems (Lee, 2023) which could potentially limit content coverage (ibid, 2019). However, proponents of constructivism argue that the depth of understanding and critical thinking skills developed outweigh the trade-off in content coverage (Morin et al., 2020; Ritter & Mostert, 2017). Therefore, efficient planning and facilitation of materials can optimize learning time and ensure learners engage in meaningful activities (Archambault et al., 2022; van Diggele et al., 2020). Studies such as Ritter and Mostert (2017), Au and Valencia (2019) Minshew (2022), and Xing et al. (2022) highlight yet another challenge of assessment and evaluation and argue that traditional assessment methods, such as standardized tests, may not adequately capture the multifaceted learning outcomes associated with constructivist approaches. This supports the study by Raj et al. (2021) that innovative and authentic assessment strategies are being explored, such as portfolios, project-based assessments, self-assessment, and peer assessment, to capture the complex and multidimensional learning outcomes inherent in the constructivist learning process.

1.1.2. The community of inquiry framework in the learning process

The community of inquiry (CoI) framework, devised by Garrison, Anderson, and Archer (1999), offers a comprehensive perspective on online learning environments,

focusing on three crucial elements: cognitive, social, and teaching presence. These components work in tandem to establish a sense of community, fostering meaningful learning experiences in both online and traditional educational settings. This framework serves as a valuable guide for examining factors influencing the formation of a dynamic online learning community and its implications on student experiences and outcomes, especially during crises (Alzayed & Alabdulkareem, 2021).

Cognitive presence, as defined by Garrison et al. (2001) pertains to learners constructing meaning through sustained reflection, discourse, and inquiry, encompassing critical thinking, problem-solving, and knowledge-construction activities. While online education has gained popularity for its flexibility and accessibility (Wang et al., 2016), concerns arise about the quality of learning experiences (Alam, 2022a). As cognitive presence herein involves interactive discussions, collaborative projects, and challenging activities that promote higher-order thinking skills (Maranna et al., 2022) assessing the ability of online learning in these skills can be achieved by actively engaging students in the learning process and interactive activities such as group discussions and problem (Tang et al., 2020) which can enhance their motivation and participation (Köksal et al., 2023). Social presence in online learning, emphasizing learners' sense of belonging and interpersonal interaction (Peacock & Cowan, 2019) involves building relationships and creating a supportive environment (Garrison et al., 1999, 2001). Utilizing online discussions, group activities, and multimedia tools enhances social presence, fostering a sense of community (Peacock & Cowan, 2019) and providing valuable insights into the impact of online interactions on student satisfaction, motivation, and community sense (Suhendi et al., 2021). Lastly, the teaching presence allows researchers and educators to understand the role of instructors in creating engaging and supportive online learning experiences through instructional design, organization, and facilitation of learning activities (Caskurlu et al., 2020; Garrison et al., 1999; Wang & Liu, 2020).

Online education can be effective for knowledge acquisition but may be less so for higher-order thinking skills like critical thinking and collaborative learning (Davis et al., 2019; Kim, 2020) as well as the balance among cognitive, social, and teaching presences (Geng et al., 2019; Rapanta et al., 2020). Concerns exist about the limitations of online interactions in fostering social presence (Chen & Bogachenko, 2022; Delello et al., 2019), as online discussions, group activities, and multimedia tools can enhance social presence, they may not fully replicate the richness and spontaneity of face-to-face interactions (Garrison et al., 2001; Munday, 2021). Thus, the absence of face-to-face interaction in online settings hinders the development of such skills (Davis et al., 2019). Therefore, collaborative skills development may also be limited, in terms of social learning, in online environments (Vuopala et al., 2016). Moreover, the CoI framework may not fully capture the diverse and unique experiences of different learners across cultural contexts (Greenhow et al., 2022) ensuring inclusivity and accounting for the diverse needs and perspectives of learners (Falloon, 2020), in particular marginalized learners.

1.1.3. Universal design for learning as an approach

Universal design for learning (UDL) aims to create inclusive learning environments by offering flexible opportunities that address diverse student needs (Ferguson et al., 2019). In addition, UDL recognizes that learners vary in their learning styles, preferences, abilities, and backgrounds (Black et al., 2015; Ralabate, 2011). It aligns with the COI framework's focus on social, cognitive, and teaching elements and complements constructivist views in education in terms of student-centric approaches (Jones, 2020). Online learning that embraces UDL principles provides options for students to express their understanding and knowledge through different means of engagement, such as interactive activities, discussions, and multimedia projects (Johnson et al., 2017). By critically analyzing the design of online learning materials, we can assess the extent to which they support the diverse ways in which students process and demonstrate their learning.

Critically examining UDL in online learning, specifically in accommodating diverse learners and promoting inclusivity, involves assessing how online platforms address various learning styles, preferences, and abilities (Fornauf & Erickson, 2020). Rogers-Shaw et al. (2018) challenge the perception of online learning as universally inclusive and accessible, emphasizing challenges in ensuring equal access (Selvaraj et al., 2021). This limitation hampers inclusive and meaningful learning opportunities (Munday, 2021). Factors like the availability of assistive technologies, platform compatibility with accessibility tools, and content format alternatives significantly impact the inclusivity of online learning experiences (Alam, 2022b; Hromalik & Koszalka, 2018).

1.2. Problems to be resolved

RQ1: How do students perceive online learning compared to traditional face-to-face teaching in the post-pandemic era?

RQ2: What are the key preferences of students' post-pandemic perspectives on online learning environments?

1.3. Objectives of the project

The purpose of this study is to explore the post-pandemic views and experiences of students regarding the quality of online learning in comparison to traditional face-to-face teaching while also examining the experience and motivation underlying online learning.

2. METHODS

2.1. Data collection and sample

The data for this study was collected from four courses offered at Mid Sweden University during the period from spring 2021 to spring 2023 and includes the following courses: "Microeconomics theory and industrial organization B," "European economic integration," "Macroeconomics A," and "Management Accounting for Human Resource". To achieve this, we have adopted a quantitative and qualitative approach. By utilizing qualitative research design, we delve into students' perceptions and motivations in remote learning, using in-depth interviews and surveys to uncover challenges, coping strategies, and evolving attitudes. The use of quantitative research design establishes statistically significant patterns, correlations, and trends in students' perceptions and performance. We distributed the questionnaire of 10 questions, anonymously to 65 students attending various courses, including 14 from Microeconomics B, 11 from European Economic Integration, 14 from Macroeconomics A, and 26 from Management Accounting for Human Resource. We selected students from different stages of the economics program to ensure a randomized sample.

2.2. Data analysis

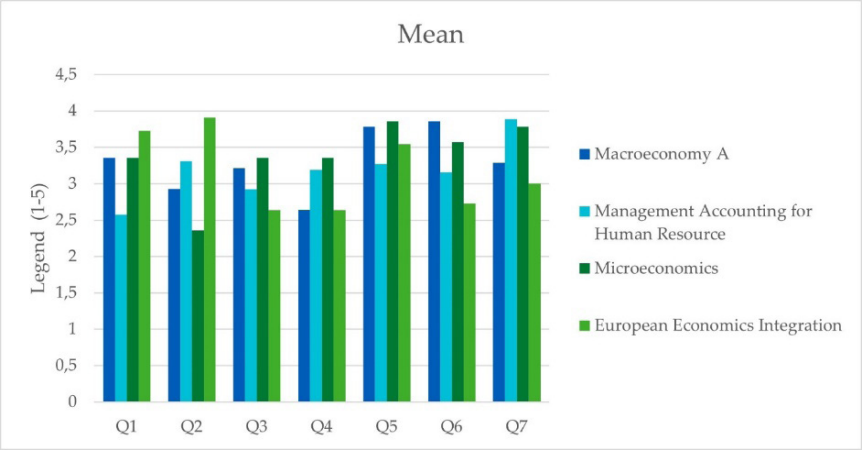
The questionnaire consisted of 10 questions from which 7 were quantitative-based and 3 were qualitative-based, hence the data analysis was done respectively. The purpose of the analysis was to examine the main effects of two independent variables (the group of online students and the group of in-class students) and their interaction on the dependent variable (the students' perception of the quality of online teaching). By conducting a two-way ANOVA without replication for the quantitative analysis, we analyze the effects of the two categorical independent variables on a continuous dependent variable. For the qualitative data, we employed Braun and Clarke's (2006) thematic analysis to find, analyze, and describe patterns which featured open-ended replies that allowed for in-depth analysis. Firstly, we initiated the process by transcribing and organizing the interviews. Following this, we created a set of codes that aligned with our research objectives, encompassing themes such as Perceptions of Digital Learning, Social Interaction and Community Building, Adaptive Learning Environments, Challenges and Coping Strategies and Pedagogical Improvements. As data analysis progressed, we categorized similar responses using these codes, facilitating the identification of commonalities and differences. Our analysis then involved a meticulous interpretation of these themes and drawing connections to our research objectives.

3. EVIDENCE OF IMPACT

3.1. Descriptive statistics

The data presented in Figure 1 represents the average (mean) responses gathered from seven multiple choice questions. These questions were part of questionnaires administered in four separate courses.

Figure 1. The mean of responses from questionnaires in four different courses.



A summary of statistical measures for two sets of data are shown in Table 1: the first set comprising seven questions (Q1 to Q7) and the second set consisting of four different courses.

Table 1. Statistical Summary, questions and courses analysis.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
Q1	4	13,01848	3,25462	0,234565
Q2	4	12,5025	3,125624	0,425454
Q3	4	12,13087	3,032717	0,102445
Q4	4	11,82867	2,957168	0,138992
Q5	4	14,45754	3,614386	0,070723
Q6	4	13,30969	3,327423	0,243484
Q7	4	13,95604	3,489011	0,174999
Macroeconomic A	7	23,07143	3,295918	0,187804
Management Accounting for Human Resource	7	22,30769	3,186813	0,158495
Microeconomics	7	23,64286	3,377551	0,246113
European Economics Integration	7	22,18182	3,168831	0,298701

Table 2 presents various statistical measures, including means, standard deviations, and counts, for four distinct courses, and offering insights into the distribution and characteristics of data within each course based on seven questions.

Table 2. Statistical analysis of four courses: Mean, deviation, and distribution comparison.

1								
2	***Macroeconomic A***		***Management Accounting for Human Resource***		***Microeconomics***		***European Economics Integration***	
3								
4	Mean	3,295918367	Mean	3,18681319	Mean	3,37755102	Mean	3,168831169
5	Standard Error	0,163795907	Standard Error	0,15047323	Standard Error	0,187507231	Standard Error	0,206571087
6	Median	3,285714286	Median	3,19230769	Median	3,357142857	Median	3
7	Mode	#N/A	Mode	#N/A	Mode	3,357142857	Mode	2,636363636
8	Standard Deviation	0,433363234	Standard Deviation	0,39811475	Standard Deviation	0,496097501	Standard Deviation	0,546535725
9	Sample Variance	0,187803693	Sample Variance	0,15849535	Sample Variance	0,246112731	Sample Variance	0,298701299
10	Kurtosis	-0,67751323	Kurtosis	1,66956658	Kurtosis	3,585157416	Kurtosis	-2,17151026
11	Skewness	-0,09787079	Skewness	0,35820107	Skewness	-1,6758355	Skewness	0,343587728
12	Range	1,214285714	Range	1,30769231	Range	1,5	Range	1,272727273
13	Minimum	2,642857143	Minimum	2,57692308	Minimum	2,357142857	Minimum	2,636363636
14	Maximum	3,857142857	Maximum	3,88461539	Maximum	3,857142857	Maximum	3,909090909
15	Sum	23,07142857	Sum	22,3076923	Sum	23,64285714	Sum	22,18181818
16	Count	7	Count	7	Count	7	Count	7

3.2. Statistical results

First, a one-way analysis of variance (ANOVA) using Excel software was performed to investigate if there is any significance among the means of score in various courses. Results indicated that there is not any significant difference at the significance level of 0.05 within the mean of scores within courses. In addition, the one-Way ANOVA was conducted to investigate if there is any significance among the means of score in various questions. Results indicate no significant difference in mean scores within courses at a 0.05 significance level. In addition, two-way ANOVA without replication found no significant differences in mean course or question scores, supporting the conclusion that the mean scores are the same within both courses and question sets (Table 3).

Table 3. Results of two-way ANOVA.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	1,375919	6	0,22932	1,039538	0,432695	2,661305
Columns	0,201228	3	0,067076	0,304064	0,822074	3,159908
Error	3,97076	18	0,220598			
Total	5,547906	27				

3.3. Qualitative analysis

In our comprehensive analysis of students' feedback on their experiences with online learning, several key themes and suggestions for improvement emerged.

3.3.1. Is there something you want to change about online learning?

To this question, the respondents pointed 'Enhancement of educational programs and teacher training', 'Increased student engagement', 'Improved teaching pedagogy', 'Technological enhancements', 'Attitudes towards online learning', 'Administrative improvements', and 'Platform preferences'. The multifaceted nature of the challenges and suggestions presented by the students necessitates an integrated approach to online education. Students express a desire for improved online education through enhanced educational programs and teacher training, emphasizing the need for professional and well-structured online platforms like Teams or Discord over Zoom. With that said, technological enhancements were deemed crucial, with students requesting high-quality equipment, user-friendly platforms, and technical support to address technical challenges. Increased student engagement was also highlighted, with students advocating for more interactive learning experiences and live interactions to foster peer engagement and group exercises. This leads to improved teaching pedagogy that was emphasized, calling for well-structured lessons, diverse teaching methods, and engaging activities.

3.3.2. Preference between online teaching, classroom teaching or hybrid teaching in the future? And why?

The exploration of students' preferences for future teaching methods—online, classroom, or hybrid—yielded diverse responses, unveiling nuanced insights into the factors influencing their choices and offering implications for the future of higher education. Key themes emerged such as 'Accessibility and inclusivity', 'Flexibility and convenience', 'Social Interaction and learning atmosphere', 'Personalization and adaptability', and 'Challenges and Suggestions for Improvement'. Throughout the qualitative part of the data a preference for hybrid teaching was highlighted due to its potential to enhance accessibility, particularly for individuals with socioeconomic challenges, caretaking responsibilities, distant residence, or housing difficulties. This made students highly value the flexibility and convenience offered by hybrid and online teaching methods, highlighting the ability to participate remotely, control study schedules, and learn in diverse environments. While appreciating the flexibility of online learning, students acknowledged the importance of social interactions and a conducive learning atmosphere, favoring the hybrid model for a balanced approach. The flexibility and inclusivity of the social aspects further led to the need for adaptable teaching methods that surfaced, emphasizing the importance of personalization, and tailoring the

learning experience to individual needs. Despite the positive aspects, students also raised concerns about time management, content structure, and the necessity for consistent teacher-student interactions. Constructive suggestions were provided, reflecting an initiative-taking willingness to contribute to shaping the future of education.

3.3.3. The key advantages and challenges in online education

The gathered data from diverse participants provided valuable insights into the advantages and challenges associated with online education. The responses highlighted various perspectives, shedding light on both the positive aspects and difficulties faced by students in this mode of learning. Advantages include the flexibility and accessibility of online education, allowing individuals to learn from any location and accommodating those with jobs in different cities. The ability to attend lectures remotely fosters inclusivity and supports individuals with caretaking responsibilities. Time efficiency and reduced environmental impact were also recognized as advantages, with students appreciating the saved commuting time and environmental benefits. Recorded lectures were seen as advantageous for flexible learning, and organized schedules enhanced the overall learning experience. Challenges in online learning, such as the absence of social interaction, face-to-face communication, and technological issues, hindered motivation and learning richness. Inconsistent lesson delivery methods and varying exam difficulty levels, coupled with limited teacher support, posed significant concerns for student comprehension and performance, emphasizing the importance of addressing these challenges to improve the overall online learning experience.

4. DISCUSSION

This study assesses students' opinions on online learning in contrast to traditional face-to-face teaching during the pandemic in four courses in Mid Sweden University. The one-way ANOVA results show no significant difference in mean scores across courses or questions for online learning perceptions at a 0.05 significance level. Similarly, two-way ANOVA without replication confirms no significant difference in mean scores for both courses and questions. Moreover, the findings from the open-ended questions unveil a nuanced landscape, showcasing diverse perspectives influenced by factors such as academic backgrounds, disciplines, and education duration. The observed discrepancies in students' views highlight the complexity of online education experiences. It emphasizes that a universal approach may not be effective, advocating for tailored, course-specific strategies to address unique challenges and opportunities in diverse academic subjects. Recognizing these provides valuable insights for educators and researchers, guiding the improvement of the overall online learning environment. Based on these findings, educational institutions ought to adopt flexible approaches to online education, catering

to diverse student backgrounds and disciplinary requirements, enhancing overall learning quality. This results in enhanced teaching approaches highlighted, advocating for organized lesson plans, varied instructional techniques, and interactive learning experiences. Therefore, underscoring the need for adaptable, student-centric approaches and targeted strategies for course-specific aspects to promote inclusivity and effectiveness across academic contexts. In comparing online and traditional teaching, it is crucial to note that while online education offers flexibility and personalized experiences, it presents challenges in tailored support and individualized instruction (Davis et al., 2019). Addressing challenges related to social interaction, technology, motivation, and support systems is vital for enhancing the online learning experience. Therefore, it is crucial to balance social and cognitive presence, enhancing engagement, and motivation, and fostering an environment for meaningful online learning and collaboration to thrive.

This research contributes significantly to improving online teaching and learning, offering insights to institutions into factors shaping student perspectives. Incorporating principles of constructivism, the CoI framework and UDL fosters an adaptive, engaging, and inclusive learning environment. The study emphasizes the importance of allocating resources to educator training, anticipating a profound impact on enhancing overall online education quality.

5. CONCLUSION

These theoretical frameworks built upon the insights gained from this study, prompt avenues for future research. Firstly, based on the limitation of the study, the low participant number impacts the generalizability of findings. Therefore, a more extensive investigation involving a diverse and comprehensive participant pool across various courses and disciplines could provide a deeper understanding of students' perceptions and behaviors in online education. This broader scope would uncover nuanced insights associated with different academic subjects. Future research should also explore cross-cultural contexts to understand variations in attitudes toward online education, contributing to a holistic understanding of challenges and opportunities. Additionally, focusing on strategies addressing challenges like social interaction, technology integration, and motivation, along with investigating innovative approaches, can improve online learning experiences. Finally, future research should cover more the evolving technologies and pedagogical approaches to enhance the quality of online education.

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