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WhatsApp as a Tool to Facilitate Continued Adjustment of First Time Entering Students Into University During COVID–19 Lockdown Restrictions

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Abstract: The Covid-19 pandemic forced universities into emergency remote learning. For universities situated in a country where internet connectivity prices are high, network coverage is low, and most students live in rural areas, this presented a unique set of problems. One of the issues is that traditional orientations were face-to-face for first-time entering students (FTENs) at universities, and they had to be moved online due to lockdown restrictions and the desire to save the academic year. For the university concerned, this presented challenges in accessing students due to their low digital literacy skills and infrastructure limitations. The study employed a quantitative exploratory research approach to assess whether WhatsApp, a low-cost communication tool offering features like affordable data bundles, group creation, and accessibility, could facilitate student engagement and support during the COVID-19 lockdown at a rural university campus. The aim was to investigate if utilizing WhatsApp could foster a sense of belonging among students, potentially mitigating dropout rates and preventing students from falling behind. The hypothesis posited a positive correlation between using WhatsApp for academic support and student retention, ultimately leading to enhanced success rates. The study used the 'Academic Dropout Wheel, a theoretical framework developed by Naaman (2021), which identifies key factors contributing to academic dropout and provides strategies for intervention. The results of a quantitative questionnaire on 181 of the 2022 cohort of FTENS at the campus revealed that students felt more at ease, had a feeling of belonging and ownership of the university, and knew where to ask for help through the effective use of WhatsApp. This paper concludes that if professionally managed, WhatsApp can be an effective tool to facilitate continued adjustment and integration of FTENs into the university.

Keywords: WhatsApp, First-time entering students, e-Learning, Orientation, Student success, Academic dropout wheel

1. Introduction and Background

The Covid-19 pandemic forced universities into emergency remote learning. For universities situated in a country where internet connectivity prices are high, network coverage is low (Simamora, 2020; Tadesse & Muluye, 2020), and most students live in rural areas, this presents a unique set of problems. Transitioning from high school to a university can be a challenging experience for many students, particularly those entering a new academic atmosphere with greater autonomy and a higher workload (McMillan, 2013). Unlike high school, university students are expected to take greater responsibility for learning, manage their time, and set academic goals(Ayish & Deveci, 2019). This shift can be difficult for some students, especially those accustomed to receiving more guidance and support from their teachers and families.

The nature of learning and social integration of First Time Entering (FTENS) students into higher education can be effectively enhanced with social media in education. Iranmanesh et al. (2022) concur with Maphosa, Dube, and Jita (2020), who applaud WhatsApp as the most popular instant messaging technology that has created opportunities for online cooperation and teamwork among students in the university context. WhatsApp can serve as a platform for learners to share and construct knowledge by interacting on topics of interest, even when they are miles away from one another. It is also claimed that virtual writing via WhatsApp improves student writing skills (Issa & Alsaleem, 2014) and offers quick and easy access to links for study materials using a technology that students use even outside school hours (Bouhnik & Deshen, 2014). However, there has been less research on how WhatsApp could be used to integrate first-time entering students into the university.

WhatsApp has become a valuable tool for first-time entering students (FTENS) in South Africa as they navigate the challenges of adjusting to university life. The~~se~~ students from the institution where the study was conducted are primarily from rural areas and have limited access to digital literacies and resources (Duma et al., 2021), which can be a significant obstacle in their academic journey. An internal study conducted by Matope in 2018 at the same institution revealed that over 80% of students came from rural high schools. Data from the university

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student tracking unit in 2023 also indicated that 90% are first-generation students. As such, they come to the university with low cultural capital, making them more vulnerable to onboarding challenges (Pendakur & Harper, 2023)

With COVID-19 lockdowns and restrictions, students had to study from home, making it challenging to access the social and academic support universities offer (Al-Maskari, Al-Riyami & Kunjumuhammed., 2022). However, WhatsApp became a crucial, easy-to-use tool for FTENS to stay connected to their peers, instructors, and support staff(Ajani & Khoalenyane, 2023). The affordability of social bundles given to students by the university monthly meant that students could access the app at a lower cost. Thus, WhatsApp has become a popular and accessible platform for communication and collaboration.

Entry-level smartphones taunt WhatsApp as a central feature, and 90% of South Africans accessing smartphones (Miyajima, 2020) makes WhatsApp a low-level access tool. The advantage of WhatsApp is that one does not need a sophisticated, costly smartphone. There are many versions of cheaper smartphones on which WhatsApp can be downloaded (Maniar & Modi, 2014; Udenze, 2017). The app's group creation feature, which allows for up to 250 participants, is precious for FTENS as it enables them to form study groups, connect with their peers, and seek academic support from their advisors and mentors. Additionally, WhatsApp is easy to use and widely available, making it an excellent choice for students who may not be tech-savvy.

University dropout rates in South Africa are high, with estimates of 90% (Moodley & Singh, 2015). To help address these challenges, universities have developed programs to support student success. The student success unit at the University in this study, under the Directorate of Learning and Teaching and the Student Development and Support Services Directorate, provides psychosocial support through sports and recreation, counseling, and other mentoring programs. This study explores whether using WhatsApp for student academic support in a rural university, with affordable data and group features during the COVID lockdown, can foster a sense of belonging and potentially reduce dropout rates. The study answers the following research questions: Did students perceive a sense of belonging to the university through their interactions on WhatsApp? Were students able to identify and join extracurricular activities based on information shared within WhatsApp groups? Did students feel that WhatsApp assisted in improving their academic performance and satisfaction? According to the students, how effective was the WhatsApp group in providing academic support?

This paper shows how WhatsApp was used at a rural university to create feelings of social and academic integration even though students were distant. It continued orientating the students into campus life after lockdown restrictions were eased.

2. Literature Review

2.1 Using WhatsApp in Teaching and Learning

Research on the use of WhatsApp in teaching and learning has shown its potential to enhance communication and interaction between students and lecturers (UJAKPA et al., 2018). It has also been helpful in higher education institutions, promoting tech-savviness and student self-expression (Enakrire & Kehinde, 2022). WhatsApp's features can be leveraged in English language teaching to improve students' language abilities (Jasrial, 2019). However, the successful use of WhatsApp in teaching and learning is contingent on the establishment of clear rules of engagement and group ownership (Gachago et al., 2015)

2.2 Building a Sense of Belonging Using WhatsApp

First-year students bring several issues with them to university. Naong et al. (2009) from their study revealed that language of instruction, amount of work, time management skills, independence levels, and lack of family support could add to the existing anxiety. Strydom & Mentz (2009) state that first-year orientation allows new students to become familiar with the university environment and resources, meet other students and learn about university life's academic and social expectations. Maunder (2018) found that how students were attached to their peers directly correlated to the feeling of belonging to the university; the more they are attached, the more they feel attached, and vice versa. Soria & Stubblefield (2015) articulate that belonging increases retention at school, with Dixon (2018) and Fabris et al. (2023) exclaiming how WhatsApp increases a feeling of belonging to a community with a common cause.

2.3 WhatsApp Helps Students Adjust to University Life

Many studies have highlighted the benefits of first-year orientation programs in helping students adjust to university life. Evensen (2017) and Larmar and Ingamells (2010) emphasize orientation programs' role in

providing information about campus resources and support services and creating a sense of community and belonging. Pickard and Brunton (2020) further underscore the importance of social group development in aiding the transition to university, a factor often facilitated by orientation programs. Wintre and Yaffe (2000) add a unique perspective by exploring the influence of students' relationships with their parents on their adjustment to university, suggesting that these relationships can also play a significant role in the transition process.

2.4 Orientation Helps Students to Learn About Academic Expectations

First-year orientation programs play a crucial role in helping students understand the academic expectations of the university (M. Evensen, 2019; Olani, 2009).These programs provide a platform for students to familiarize themselves with campus life, interact with faculty, and learn about the differences between high school and university expectations (M. Evensen, 2019). Transitioning from high school to university can be challenging, and students often have unrealistic expectations about university life (Mcphail, Fisher & Mcconachie, 2009). Therefore, orientation programs must address these misconceptions and provide students with the necessary information to succeed academically (Crozier, 2021).

Orientation programs are crucial in helping students transition into the higher education environment and feel connected to the university community (Robinson et al., 1996). This is particularly important in online learning, where orientation materials can significantly impact student success (Tomei et al., 2009). Furthermore, orientation programs can also provide opportunities for students to engage with the university and their peers, leading to a sense of belonging and investment in their education (Altschwager, Dolan & Conduit, 2018).

This study's student success unit at the University is based on collaboration between academic support, psychosocial support, and faculty. It plans and executes orientation programs and provides psychological and social support through sports and recreation, counseling, and other mentoring programs. The unit also addresses academic support needs through interventions such as writing assistance, digital literacies, academic advising, and other peer assistance programs such as residence, health, and eLearning.

3. Theoretical Framework

The study is underpinned by Tinto's Integration theory of 1993 and Naaman's (2018) Dimensions of Academic Dropout" wheel. These underscore the need to use WhatsApp to introduce the FTENs to the university culture, vision, and mission by creating a sense of belonging and confidence in the new academic space. These are discussed below.

3.1 Tinto's (1993) Integration Theory

Numerous studies show that student support can reduce the dropout rates of students, with Chrysikos, Ahmed & and Ward (2017) explaining Vincent Tinto's (1993) model as identifying three significant sources of student departure: academic difficulties, the inability of individuals to resolve their educational and occupational goals, and their failure to become or remain incorporated in the intellectual and social life of the institution. Tinto's "Model of Institutional Departure," shown in Figure 1, states that to persist, students need integration into formal (academic performance) and informal (faculty/staff interactions) academic systems and formal (extracurricular activities) and informal (peer-group interactions) social systems.

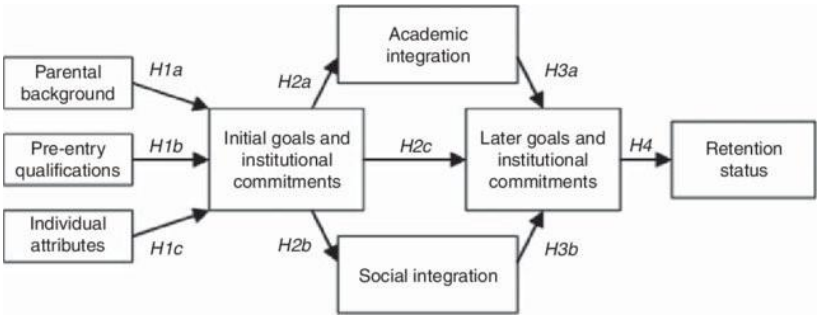

Figure 1: The initial student integration model is based on Tinto's (1993) student integration theory

3.2 Naaman's (2018) Dimensions of "Academic Dropout Wheel"

Naaman (2018) Examined factors influencing the student-institution relationship that could potentially contribute to dropout occurrences and created the "academic dropout" wheel. The model has five (5) layers speaking to each dimension.

1. **Personality**: This embodies the primary traits developed during the early stages of a student's life and is influenced by all other dimensions; hence, it is at the model's core. Tosevski et al. (2010) state that personality traits are strongly linked to the coping styles individuals adopt in navigating the challenges of everyday life, and McLaughlin, Moutray, Muldoon et al. (2008) also confirmed that despite certain personality traits being predisposed to dropping out, retention can be built by encouraging integration among students.
2. **Internal dimensions:** Inherent physical and psychological aspects of a student that are beyond their control can lead to prejudgments from others based on visible characteristics.
3. **External dimensions**: Most aspects are controllable and refer to a student's relationship with the outside world and affect people's career choices and connections.
4. **Academic dimensions:** An additional layer to the original model of Gardenswartz & Rowe (2009). They include the academic features that distinguish one student from another.
5. **Organizational dimensions:** A layer representing all the institution's cultural aspects that can directly affect the student's academic trajectory and influence how people are treated and their development within the organization.

This paper seeks to answer whether WhatsApp can be used as an orientation tool to impact the academic dimension of the dropout wheel. The Academic includes researching library (Brown, 2015) topics, attending labs and classes, and engaging in various activities related to academic success (Bekkering & Ward, 2021). It is divided into extra-curricular and co-curricular participation, feeling of belonging, and academic integration, performance, and satisfaction.

3.2.1 Feeling of belonging

The feeling of belonging, defined as the extent to which students feel accepted, respected, included, and supported, is crucial in preventing academic dropout (Pedler, Willis & Nieuwoudt, 2022; Stojanović & Popović-Ćitić, 2022). This sense of belonging is linked to various positive outcomes, including academic achievement, motivation, and engagement (Tomić, Stojanović, & Antović., 2022). In higher education, a strong sense of belonging is associated with higher motivation and enjoyment, which in turn can reduce the likelihood of dropout (Pedler. Willis, & Nieuwoudt., 2022). Naaman's (2018) Academic Dropout Wheel identifies dissatisfaction with the program and academic failure as critical antecedents of higher education dropout, suggesting that a lack of belonging may contribute to these factors. Goodenow (1993) further supports the importance of school belonging, finding that it is significantly associated with academic motivation among urban adolescent students. Therefore, fostering a sense of belonging is crucial in preventing student dropout.

3.2.2 Extra-curricular and co-curricular participation

Research has consistently shown the importance of extra-curricular and co-curricular activities in preventing student dropouts. Marcelino-Jesus et al. (2016) emphasizes the role of academic centers and initiatives in helping students adapt to academic life. Mahoney (1997) found that involvement in school-based extracurricular activities significantly reduced the dropout rate among at-risk students. Naaman (2021) further underscores the significance of these activities, identifying dissatisfaction with the program and academic failure as critical antecedents of higher education dropout. Manzuoli Pineda-Báez, & Vargas Sánchez. (2019) highlight the need for students to engage in activities that enhance their cognitive and agentic dimensions, which can be achieved through participation in extra-curricular and co-curricular activities.

3.2.3 Academic performance and satisfaction

Academic performance and satisfaction are critical factors in student dropout, as highlighted by Naaman (2018) and supported by Quadri (2010), Stinebrickner (2013), and Suhre, Jansen, & Harskamp,. (2007). Naaman's "Dimensions of Academic Dropout" wheel, as in Figure 2 below, identifies dissatisfaction with the program and academic failure as significant antecedents of higher education dropout. This is further underscored by Quadri's use of data mining to predict dropout, which found that academic performance is critical. Stinebrickner's (2013) dynamic learning model of college dropout also emphasizes the role of academic performance, with poor performance leading to decreased enjoyment of school and influencing beliefs about post-college earnings. Suhre,Jansen, & Harskamp's , study on degree program satisfaction further supports this, showing that decreased satisfaction can diminish study motivation and behavior, ultimately impacting academic accomplishment and dropout. Therefore, understanding and addressing academic performance and satisfaction are crucial in preventing student dropouts.

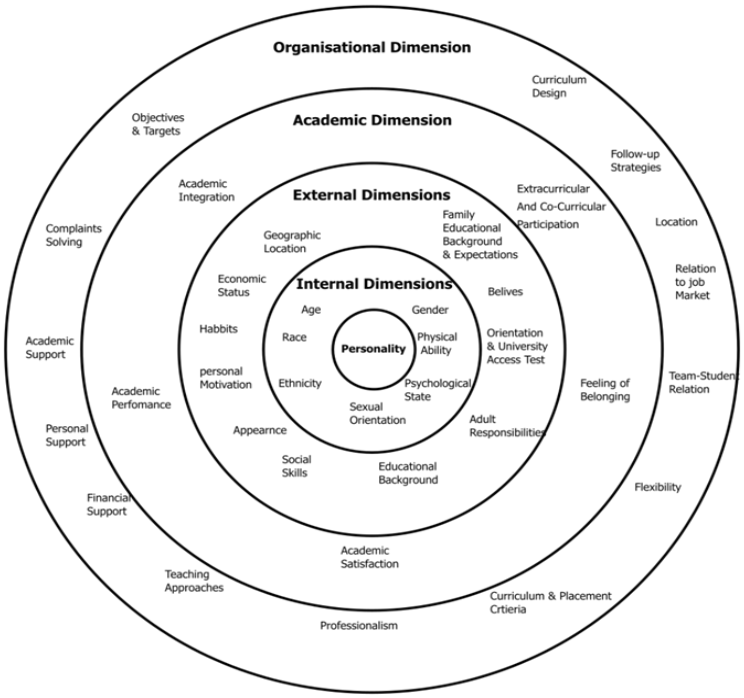

Figure 2: Academic Dropout Wheel (adapted from Naaman, 2021)

WhatsApp, a low-cost digital application, can integrate first-year students as soon as they are admitted and registered by the university. In this study, students were registered in the first-year students' group, where the eLearning administrator shared information about the university. Through this, an educational environment was created by creating multiple sources with simulations of the university context. This helps alleviate the fears and anxiety of first-year students who have no prior knowledge of university life from their families. This low cultural capital of first-year students is one primary source of anxiety for undergraduate students during their first year in university.

4. Research Methodology

The study employed a quantitative research approach. An open-ended questionnaire on a Likert scale was used to collect data to generate tables and graphs. Data was collected from a sample of 181 FTENs. Five WhatsApp groups were created for first-time students entering the campus level; the links were sent to phone numbers of students who applied to the university. Every student was sent a link to a group associated with their study department, with an option to leave should there be a mix-up. The administrator of the groups is the campus eLearning administrator, who communicates official, just-in-time messages to first-time entering students and interventions by the Directorate of Teaching and Learning, Student Success Team. The questionnaire was sent to all groups towards the year's end to gauge their effectiveness concerning the research questions. The questionnaire was sent to a senior researcher in the department for critical review before they were used to collect data. This was done to ensure that the questions measured what they were expected to measure regarding addressing the sub-research questions.

Before data collection, the university gave the researchers ethical clearance, allowing them to collect data from the students. The students sampled to participate in the study were issued a consent form where the ethical concerns were addressed. The students were informed that they could withdraw from the study if they felt their rights were being violated.

The academic dropout wheel's academic dimensions (Naaman, 2021) are used to create interventions that seek to improve the feeling of belonging, academic satisfaction, integration, and performance, and when lockdowns eased to allow the promotion of extracurricular activities. A questionnaire was drafted using a 7-point agreeableness Linkert scale; the nature of the data is qualitative; however, Linkert scales transform attitude and perception data into qualitative data (Dermo, 2009) by asking the respondents to choose the extent to which they agree or disagree.

5. Data Presentation

5.1 First Question: Biographical Background

One hundred and eighty-one (181) FTENs responded to the questionnaire; 116 responded as female, 63 as Male, one as non-binary, and one preferred not to say. One hundred and forty-one students responded as being accommodated in residences, 35 rented off-campus, and five lived at home; 67 indicated having family, friends, or people they knew around the campus city before coming to this campus, and 114 knew no one, 99 students stated that they have a good internet connection and 82 without.

On the issue of funding, one hundred and fifty-five (155) of the National Student Financial Scheme funded students; 6 had bursaries, and 20 were self-funded. One hundred eighty indicated having a laptop or cellphone, and only one indicated not having either. One hundred and forty-five participants indicated they were in WhatsApp groups created by the campus's Directorate of Learning and Teaching. They also indicated that they had a chance to interact with their peers through the WhatsApp platform before coming to the university. They also indicated that they had a chance to interact with their peers through the WhatsApp platform before coming to the university. This indicates that fourteen (14) of the FTENS who participated in the study were either not on WhatsApp or, therefore, had not yet joined the group. Thus, they did not benefit from the activities and information sharing with their peers.

5.2 Feeling a Sense of Belonging

For the second question, from the dropout wheel, we asked five questions to check if the students felt they belonged in the university because of WhatsApp interactions. The first question was, "I felt welcomed at the university since I joined the WhatsApp groups," The second question was, "WhatsApp groups help you to feel connected to academic support (eLearning, Pals, academic advising)" the third question from WhatsApp groups, "I feel that people at DLT (Directorate of Learning and Teaching) understand me as a person," forth question was, "I have made positive relationships with my peers from the WhatsApp groups," and the fifth question was "The DLT WhatsApp groups are a safe, trustable space."

The survey results in Table 1: Responses on feeling of belonging indicate diverse sentiments among respondents regarding their experiences with WhatsApp groups at the university. In response to Sub-Question 1, a substantial number (65%) feel generally welcomed through their participation in WhatsApp groups, yet a significant 25% adopt a neutral stance, neither agreeing nor disagreeing. For Question 2, a majority (82%) acknowledges the positive contribution of WhatsApp groups to their connection with academic support, presenting a generally favorable outlook, with only a minor percentage expressing disagreement. Moving to Question 3, a significant portion (64%) believe that individuals at the Directorate of Learning and Teaching (DLT) understand them through WhatsApp groups; however, a notable 25% remain neutral. Regarding Question 4, a majority (76%) reports cultivating positive relationships with peers through WhatsApp groups, while a smaller percentage expresses disagreement or neutrality. Finally, in Question 5, while a majority (66%) considers DLT WhatsApp groups safe and trustworthy, about one-fourth of respondents express some level of disagreement or neutrality, suggesting a varied perception of the reliability and security of these platforms. These findings collectively reflect a mix of positive experiences and areas where respondents adopt neutral or differing stances, emphasizing the need for nuanced strategies to enhance engagement and satisfaction within the university's WhatsApp group environment.

Table 1: Responses on feeling of belonging

Agreeableness	Sub-Q1(N)	Sub-Q2(N)	Sub-Q3(N)	Sub-Q4(N)	Sub-Q5(N)
Strongly agree	46	67	16	32	39
Agree	77	76	70	82	83
Somewhat agree	14	11	29	29	21
Neither agree or disagree	17	6	25	6	11
Somewhat disagree	6	4	5	5	4
Disagree	8	1	19	12	9
Strongly disagree	1	4	5	3	2

5.3 Extra-Curricular Participation Through WhatsApp

The third question was to check if students could identify and join extracurricular activities from the information shared on WhatsApp. It had two sub-questions. The first one asked if WhatsApp groups helped me find school events and activities quickly, and Sub-question 2 joined extra-curricular activities from WhatsApp group postings.

The survey results in Table 2 underscore a positive sentiment among most respondents regarding the role of WhatsApp groups in facilitating engagement with school events and extracurricular activities. An overwhelming 87% of respondents express that WhatsApp groups have been instrumental in helping them quickly discover school events and activities, with only a tiny percentage indicating disagreement or neutrality. Similarly, a majority of 84% of respondents report having successfully joined extracurricular activities through WhatsApp group postings. Despite a minor percentage expressing disagreement or neutrality, the overall sentiment remains positive. These findings collectively suggest that WhatsApp groups are valuable in connecting students with school-related events and extracurricular opportunities, contributing to a positive and inclusive university experience. Most of the evidence points to the importance of WhatsApp groups in helping students develop a feeling of belonging. Students from various backgrounds can get to know and support one another as they acclimate to the new atmosphere of higher education through social mixings. This fosters a strong sense of belonging and a sense of acceptance.

Table 2: Responses on extracurricular participation through WhatsApp

Agreeableness	Sub-Q1(N)	Sub-Q2(N)
Strongly agree	56	31
Agree	86	78
Somewhat agree	13	10
Neither agree nor disagree	5	8
Somewhat disagree	2	3
Disagree	2	33
Strongly disagree	5	6

5.4 Contribution of WhatsApp to Academic Performance and Satisfaction of Students

The fourth question was to see if the students of WhatsApp assisted with their academic performance and satisfaction. It had three sub-questions: number, one was whether WhatsApp group assistance helped them to perform better in class, whether WhatsApp groups helped them find their way around the university, and the third asked if they got valuable information about the class from WhatsApp groups.

The survey results in Table 3 reveal a strong positive sentiment among respondents regarding the impact of WhatsApp groups on their academic performance. A significant majority (83%) believe these groups have contributed to their success in class, with only a tiny percentage expressing disagreement or neutrality. Furthermore, most (81%) of students feel that WhatsApp groups have played a positive role in helping them navigate the university environment, even though there is a slightly higher percentage of disagreement than in the first sub-question. The overwhelming majority (90%) believe they have received valuable information about their classes from WhatsApp groups, and the percentage of disagreement or neutrality in this aspect is notably low. In summary, the findings suggest that, overall, students perceive WhatsApp groups as beneficial tools for both academic success and navigating the university experience, with a powerful impact on information dissemination.

Table 3: Responses on the contribution of WhatsApp to academic performance and satisfaction of students

Agreeableness	Sub-Q1(N)	Sub-Q2(N)	Sub-Q3(N)
Strongly agree	34	32	60
Agree	81	92	85
Somewhat agree	23	18	12
Neither agree nor disagree	11	3	3

Somewhat disagree	4	2	2
Disagree	12	15	2
Strongly disagree	4	7	5

5.5 Academic Integration of Students Using WhatsApp.

Most students (75%) express confidence in finding valuable academic support through WhatsApp groups, although a noticeable percentage indicates disagreement or neutrality. The overall sentiment remains positive. Similarly, Table 4 shows a comparable majority (76%) believe in the freedom to express themselves openly within WhatsApp groups, with percentages for disagreement, somewhat disagreement, and neutrality aligning with the first sub-question. Moreover, an overwhelming majority (87%) of students feel that WhatsApp groups played a significant role in helping them adjust to university studies, and the percentage of disagreement or neutrality in this regard is comparatively low. These findings collectively suggest that students perceive WhatsApp groups as valuable platforms for academic support and self-expression and for facilitating the adjustment to the challenges of university studies.

Table 4: Responses on academic integration of students using WhatsApp

Agreeableness	Sub-Q1(N)	Sub-Q2(N)	Sub-Q3(N)
Strongly agree	38	26	36
Agree	83	69	90
Somewhat agree	20	20	21
Neither agree nor disagree	13	11	4
Somewhat disagree	2	6	4
Disagree	8	30	10
Strongly disagree	5	7	4

6. Discussion of Findings

Higher education institutions can benefit from using social media tools like WhatsApp to extend the orientation of first years to a longer period. The results show that the groups increased their feeling of belonging to the university students and their knowledge and trust of the various academic support units. The information shared on social media tools assists in joining the students in co-curricular activities, which helps integrate them more into the university. Students can adjust to university and perform better when freely expressing themselves in various classes. This includes getting class times and clarifying content.

Tinto's "Model of Institutional Departure" states that to persist, students need integration into formal (academic performance) and informal (faculty/staff interactions) academic systems and formal (extracurricular activities) and informal (peer-group interactions) social systems. In higher education, a strong sense of belonging is associated with higher motivation and enjoyment, which in turn can reduce the likelihood of dropout (Pedler, Willis & Nieuwoudt 2022). Naaman's (2018) Academic Dropout Wheel identifies dissatisfaction with the program and academic failure as critical antecedents of higher education dropout, suggesting that a lack of belonging may contribute to these factors. Goodenow (1993) further supports the importance of school belonging, finding that it is significantly associated with academic motivation among urban adolescent students. Therefore, fostering a sense of belonging is crucial in preventing student dropout. Manzuoli, Pineda-Báez & Vargas Sánchez (2019) highlight the need for students to engage in activities that enhance their cognitive and agentic dimensions, which can be achieved through participation in extra-curricular and co-curricular activities. Stinebrickner's (2013) dynamic learning model of college dropout also emphasizes the role of academic performance, with poor performance leading to decreased enjoyment of school and influencing beliefs about post-college earnings. Suhre,Jansen, & Harskamp's study on degree program satisfaction further supports this, showing that decreased satisfaction can diminish study motivation and behavior, ultimately impacting academic accomplishment and dropout.

The study also noted that some students were not on the WhatsApp group. This indicates that fourteen (14) of the FTENS who participated in the study were either not on WhatsApp or had not yet joined the group. Thus, they were not benefiting from their peers' activities and information sharing. The study, however, did not collect data on why these students did not have smartphones or were not on the FTENS WhatsApp group. Lastly,

support for e-learning practice was indirectly addressed by indicating the use of WhatsApp in helping first-time entering students adjust to university courses and life as university students.

7. Recommendations and Conclusion

Orientation is a critical time for FTENS, as it allows them to become familiar with the university environment and meet their peers and lecturers. However, limiting orientation to just one or two weeks at the beginning of the academic year is not enough. As Strydom & Mentz (2009) recommend, orientation should be a program spread throughout the first year of study to ensure that FTENS receive the support they need to adjust to university life.

Implementing such strategies should be intentional, using student profiles to push interventions to FTENS and continually check for quality. This means universities should thoroughly understand their FTENS' needs, challenges, and aspirations and use this information to provide targeted and practical support. However, the findings from the data show that students generally feel that WhatsApp can be used as a tool to increase student integration or onboarding into the new university life.

Universities should investigate the future affordances of social apps and include them in future interventions. WhatsApp is a versatile social app platform that can be used for various purposes, from communication and collaboration to resource-sharing and support. By keeping up with the latest developments in the app, universities can ensure that they are using it to its fullest potential to support their FTENS.

WhatsApp as a tool for extending orientation to FTENS beyond the traditional one or two-week period has been identified as a potential solution to some of the challenges faced by first-time entering students (FTENS) in higher education institutions. The use of WhatsApp can increase the feeling of academic belonging among students, which can reduce the likelihood of dropping out. Furthermore, the integration of higher education can benefit significantly from using WhatsApp and other instant messaging apps.

One of the limitations of using WhatsApp for institutional purposes is that there is no way to link student numbers to phone numbers for student tracking and monitoring. However, group mentality and the enhanced spirit of community can be observed, as students who have never met before can coordinate bus trips trustable taxis, wait for each other in town, non-residence students can find places to stay, give each other directions and advice, and researchers can monitor all of this. In addition, students could join sub-groups for their modules, and lecturers could find students to join their WhatsApp groups by posting links on this group. High-risk events such as strikes, missing students, lost phones/bags, etc., were quickly resolved through the app. The study acknowledges that there is a scarcity of research on using WhatsApp as a tool for integrating first-year students into the university. The study thus will contribute to the body of research and might incite more research on the topic.

Data Protection and Ethical Review

Under the Data Protection Act, the researcher anonymized the information held on students, including contact details. The students were asked on WhatsApp before answering the form for permission to be involved in the research and for their information to be used; answering the form meant the student consented. The informed consent form was a statement that the students were free to withdraw from the study at any time if they thought their rights were being infringed upon. One hundred and eighty-one (181) students out of a potential 600 various FTEN WhatsApp groups responded positively to the message.

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Empowering Hearing-Impaired Learners for Digital Citizenship: A Thai MOOC-Based Design Thinking Approach

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Abstract: In today's technology-driven world, digital citizenship is vital in fostering responsible technology use and essential skills for learning, problem-solving, and community participation. However, a significant focus emerges within digital citizenship—empowering individuals with disabilities. This research addresses this crucial area by spearheading the creation of a specialized Thai Massive Open Online Course (MOOC) meticulously designed for hearing-impaired learners. The core objective is to equip these individuals with indispensable digital citizenship skills for seamless integration and active engagement in digital environments. The study progresses through three key phases. Phase 1 involves crafting the MOOC course to meet the needs of hearing-impaired individuals. Phase 2 develops a course on the Thai MOOC platform, using the MOOC-based Design Thinking Model and universal design learning principles. Phase 3 assesses 20 hearing-impaired learners in the "Utilizing Online Media as Digital Citizenship Course." The research reveals two significant outcomes, highlighting the course's impact. First, an evaluation of digital media quality and learning activities was conducted by five experts with 15 to 30 years of experience in the field, the result was an impressive performance rating of 4.56 on a 5-point Likert scale, indicating the course's high suitability for hearing-impaired learners. Such findings validate the precise alignment of the course with its intended objectives. Second, the outcomes of learning achievement tests on the Thai MOOC platform involving 20 high school hearing-impaired learners revealed that 15 learners scored above 70 (passing), representing 75%. The average post-test score was higher than the pre-test, with an average score of 72.05 points. These results demonstrate the course's effectiveness in improving learning outcomes and meeting predetermined criteria, while also indicating that adopting the MOOC-based Design Thinking model has led to the creation of high-quality media that delivers tangible results for hearing-impaired individuals. This research contributes to the eLearning field by addressing the specific needs of hearing-impaired individuals in digital citizenship education through tailored online learning courses designed to bridge existing gaps.

Keywords: MOOC, Digital citizenship, Online learning, Learning achievement, Universal design for learning, Hearing-impaired learners

1. Introduction

In recent years, there has been a significant uptick in the utilization of online media among individuals grappling with hearing impairments. Maneehaet and Saitong (2023) underscored this trend, highlighting the escalating reliance of the hearing impaired on digital devices across a spectrum of online activities. While this dependence on technology opens up new avenues, it also presents challenges. In the realm of education, the imperative to equip hearing-impaired individuals with essential digital citizenship skills is becoming increasingly pressing, particularly in the context of Thailand. As their digital footprint expands, it becomes essential for them to learn how to responsibly search, evaluate, and disseminate information (Sriwisathiyakun, 2023). Moreover, nurturing their ability to engage in meaningful conversations with diverse groups while upholding ethical and legal standards is equally crucial (Gleason and Von, 2018).

This underscores the necessity for innovative learning approaches. In the era of Education 4.0, marked by rapid technological advancements, the widespread adoption of online education presents a unique challenge for Thailand. This challenge is particularly pronounced for individuals with disabilities, emphasizing the critical need for inclusivity. The goal is to seamlessly integrate them into the digital age and equip them with the requisite knowledge and skills to navigate the digital landscape safely and effectively. Deaf and hearing-impaired individuals have historically had to exert significantly more effort than their hearing counterparts to achieve similar outcomes (Parmisana and Badilla, 2022). Thus, the researcher endeavors to develop fundamental digital citizenship content tailored to the specific needs of hearing-impaired learners, facilitating their learning through digital media on Thai Massive Open Online Courses (MOOC).

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Thai MOOCs epitomize a localized manifestation of online education, with the capacity to reach diverse audiences and offer free services. By integrating digital technologies and thoughtfully crafted learning experiences, learners can actively engage with educational content through various digital mediums, such as exercises, interactive quizzes, collaborative discussions, and practical applications. This collective approach serves to mitigate educational disparities and foster lifelong learning. However, online education for the hearing impaired necessitates a customized approach, including the enhancement of digital infrastructure and the development of pedagogical strategies tailored to their unique learning needs (Sriwisathiyakun and Dhamanitayakul, 2022). Leveraging the human-centered principles of Design Thinking, educators are empowered to innovate empathetic, tailored solutions for varied educational needs. This approach is in harmony with the Universal Design for Learning (UDL), providing a strategic framework to craft inclusive educational content and assessments, including those with special needs. UDL's guidance as well as instructional strategies for hearing-impaired learners support curricula aimed at overcoming learning barriers, increasing teaching flexibility, and securing equitable learning for every student (Meyer, Rose, and Gordon, 2014).

In the context of this research, the focus lies on outlining the methodology for developing an online course within the Thai MOOC framework, specifically tailored to meet the educational needs of hearing-impaired individuals based on the Design Thinking model, Universal Design for Learning principles and instructional strategies for hearing-impaired learners. The research aims to address the following questions: 1) How is the development of the Thai MOOC course utilizing the MOOC-based Design Thinking Model for learners with hearing impairments? 2) What are the learning achievements of hearing-impaired learners in a Thai MOOC course?

2. Literature Review

2.1 Digital Citizenship for Hearing-Impaired Learners

All learners need digital citizenship skills to participate fully in their communities and make smart choices online and in life. The concept of citizenship has evolved on a global scale, driven in large part by the significant technological revolution and rapid digital transformation (Saputra and Siddiq, 2020). The purpose of delving into digital citizenship is to establish a common and shared understanding, emphasizing the vital connection between humans and technology. Digital citizens are those who recognize the rights, responsibilities, and opportunities that come with living, learning, and working in our interconnected digital world (Ribble, 2021). World Association for Christian Communication - WACC (2017) a digital citizenship education framework comprises nine elements of digital citizenship. These categories encompass, digital access, digital commerce, digital communication and collaboration, digital etiquette, digital fluency, digital health and welfare, digital law, digital rights and responsibility, and digital security and privacy. digital literacy serves as a foundation for developing responsible digital citizenship. Individuals who possess digital literacy skills are better equipped to engage with technology safely, ethically, and responsibly (Ohdigital, 2020). In the meanwhile, digital citizenship reinforces and promotes the development of digital literacy skills, fostering critical thinking, effective communication, and responsible digital behavior. Recognizing and nurturing the interplay between digital literacy and digital citizenship is crucial in empowering individuals to navigate the digital world proficiently while upholding ethical standards and respecting the rights of others (Kritzer and Smith, 2020). The incorporation of digital citizenship and media literacy concepts, along with the analytical and creative aspects, can enhance students' grasp of academic subjects, facilitate their engagement in civic activities, and foster responsible digital citizenship (Gleason and Hutchison, 2022). For individuals who are deaf or hard of hearing, digital media serves as a vital means to access information and facilitate communication. The ability to acquire information through digital media plays a profoundly significant role in their lives (Schäfer and Miles,2023; Rachdito and Hidayat, 2022). By enhancing digital citizenship skills, individuals can engage in responsible online behavior, report inappropriate content or behaviors, and promote online safety within their networks. Digital citizenship skills and comprehensive knowledge of technology use are important for those who use signed language interpreters and who utilize them for functionally equivalent access to society and everyday activities (Napier et al., 2017).

2.2 Massive Online Open Course (MOOC) and MOOC-Based Design Thinking Model for Hearing-Impaired Learners

A Massive Online Open Course (MOOC) is an interactive online learning platform that facilitates the exploration of specific concepts. It can be accessed from anywhere at any time. Over time, MOOCs have expanded globally and have taken on various forms, such as cMOOC, xMOOC, and blended learning approaches (Blum, Stenfors, and Palmgren 2020; Babori, 2020; Mota and Scott, 2014; Zhu, 2021). Recent research has delved into the accessibility of MOOCs, considering both the perspectives of course providers and stakeholders (Iniesta et al.,

2022). An examination of studies conducted on MOOC accessibility since 2014 revealed that these platforms have made significant improvements to their features, rendering them more inclusive and user-friendly for learners with particular needs (Królak and Zając, 2022). MOOCs are widely acknowledged for their substantial potential to provide alternative educational opportunities for individuals with disabilities who encounter difficulties accessing traditional educational institutions. Despite this significant promise and their adaptability for accommodating individuals with disabilities, scholars have contended that the majority of MOOC platforms still fall short of achieving universal accessibility (Akgül, 2018). In the realm of educational accessibility, Hearing-Impaired and deaf Learners encounter profound communication barriers that impede their full integration into broader intellectual communities, thereby limiting their opportunities for success. Deafness, characterized by partial or complete hearing loss, presents linguistic challenges encompassing phonological, morphological, and syntactical aspects (Sundström et al., 2018). Moreover, individuals with hearing impairments, stemming from diverse experiences, may interpret spoken language differently.

Consequently, learners with hearing impairments may encounter difficulties in comprehending lectures that rely heavily on language comprehension, potentially impacting their academic performance (Meinzen-Derr et al., 2017). Research has shown that creating multimedia content tailored for the hearing impaired is effective in enhancing content comprehension when combining text and images, compared to content consisting solely of text or text accompanied by sign language, and using videos can have a powerful effect on learning (Deaf Unity, 2019; Mingsiritham and Chanyawudhiwan, 2020). Therefore, digital media accessibility for individuals who are deaf or hard of hearing encompasses not only the use of technological accommodations such as captioning and sign language videos but also the broader spectrum of opportunities it provides. These opportunities include fostering increased interaction, enhancing language proficiency, enriching learning experiences, and bolstering motivation when engaging with digital media (Toofaninejad et al., 2017).

Nevertheless, strategies for MOOC-based media creation must adopt a more comprehensive approach, as proposed by Dhamanitayakul et al. (2023). Dhamanitayakul et al. (2023) developed a MOOC-based Design Thinking Model specifically for hearing-impaired learners to improve educational outcomes and satisfaction. This Model underlines the importance of MOOCs for these students, emphasizing stakeholder engagement, strategic instructional methods, and adherence to UDL principles for better accessibility and learning quality. It also involves learners in creating digital media, providing social interaction, and ensuring the content meets their specific needs. The model comprises integral components, as delineated in Figure 1, which can be described as follows:

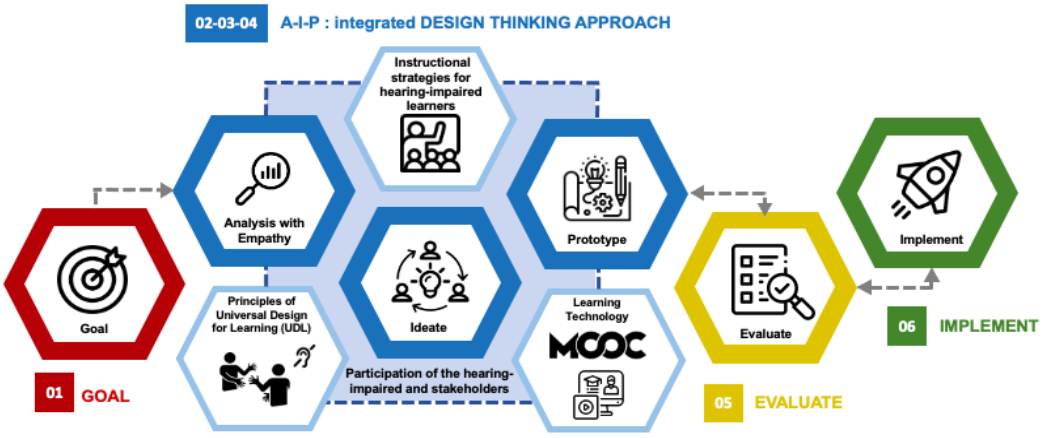

Figure 1: MOOC-based Design Thinking Model for hearing-impaired learners (Dhamanitayakul et al., 2023)

Six stages of MOOC-based Design Thinking Model for hearing-impaired learners.

- Goal (Learning objectives and target audience definition): Set clear learning objectives and identify the target audience for the MOOC. Outline the course prerequisites, craft a comprehensive syllabus, and delineate the essential particulars. Establish the specific learning outcomes aligned with the target learner group.
- Empathetic analysis: Thoroughly analyze and synthesize information with empathy to comprehend the rationale, emotions, perceptions, and motivations underlying the actions of hearing-impaired

learners. Construct a learner empathy map employing research methods such as observations, interviews, surveys, and involving stakeholders.

- Idea generation: Generate innovative concepts to address challenges and formulate appropriate media solutions for learner issues. Engage in brainstorming sessions to identify unmet requirements of hearing-impaired learners.
- Prototyping: Initiate the creation of pioneering digital media solutions, focusing initially on rapid development rather than aesthetics. Utilize prototypes to validate the effectiveness of proposed concepts in addressing the identified learner challenges. Continuously revisit the empathetic analysis and idea generation stages, modifying and enhancing the media iteratively until the defined objectives are met.
- Evaluation: Conduct thorough testing before implementation, ensuring compliance with relevant standards and compatibility with interconnected systems.
- Implementation: Execute the finalized media solutions on the MOOC platform. Incorporate them into instructional modules and maintain vigilant oversight to monitor and assess learner progress and outcomes.

Co-components of MOOC-based Design Thinking Model for hearing-impaired learners.

- Engagement of hearing-impaired individuals and stakeholders: Incorporate the active participation of individuals with hearing impairments, and experts in hearing and deafness, along with relevant stakeholders.
- Pedagogical approaches tailored for hearing-impaired learners: Employ instructional media strategically to cater to the unique needs of hearing-impaired learners. This encompasses delivering comprehensive content to participants before the course commencement, featuring distinct, clear, and audible sounds or speech.
- Integration of universal design for learning principles: Apply established design principles, such as Universal Design for Learning (UDL), to the creation of digital media that is well-suited for individuals with hearing impairments.
- Incorporation of MOOC (Learning Technology): Incorporate meticulous technical specifications, parameters, constraints, and standards as guiding principles for the meticulous development and design of instructional media.

This research employs the MOOC-based design thinking model for hearing-impaired learners to conceptualize and create a course within the Thai MOOC platform. The aim is to translate the theoretical framework of the model into a practical, tangible course that addresses the specific needs and learning requirements of hearing-impaired individuals.

3. Methodology

3.1 Course Development by Utilizing the MOOC-Based Design Thinking Model

The researcher developed the “Utilizing Online Media as a Digital Citizenship” course using the MOOC-Based Design Thinking Model, for hearing-impaired learners, as elaborated in Table 1.

Table 1: The implementation of course development using the six stages of the MOOC-based design thinking model

Stages	Implementation
01 Goal	This course, titled "Utilizing online media as digital citizenship," focuses on online media proficiency, covering key aspects like online safety, digital presence management, and fostering digital citizenship. The course is 3 hours long, and the assessment includes chapter quizzes (60%) and a final test (40%) combined to be post-test (100%), with certification requiring a minimum score of 70%. Successful students receive an official certificate.

Stages	Implementation
02 Analysis with Empathy	This study involves a thorough analysis of the experiences of individuals with hearing impairments, achieved through interviews with 3 experts who work with hard-of-hearing and deaf learners. The findings can be categorized as follows: Education and communication: Focuses on hard-of-hearing and deaf individuals, emphasizing sign language and real-time captions for effective communication. Digital citizenship for deaf adolescents: Addresses the knowledge gap in understanding online content among deaf teenagers. Tailored interventions emphasize digital rights, security, and privacy in the online context. Creating accessible digital media: Highlights the development of inclusive digital content, featuring simulation-style presentations, sign language, and real-time captions. Encourages active participation of hearing-impaired individuals in media production. Disseminating disability-related content: Stresses the importance of a respectful approach in sharing content related to disabilities. Compliance with the Thailand Personal Data Protection Act (PDPA) and obtaining consent are crucial.
03 Ideate	A collaborative meeting with the production team is scheduled. This team includes instructors, sign language interpreters, deaf performers, directors, and other stakeholders. The goal is to create guidelines for online course development, specifically tailored to meet the needs of hearing-impaired learners. The meeting will address: Guideline creation: Developing guidelines that reflect the unique requirements of hearing-impaired learners, guiding the content development process for the course titled "Utilizing Online Media as digital citizenship." Roles and collaboration: Defining roles for team members and promoting collaboration to ensure a comprehensive approach. Filming schedule and coordination: Planning media filming in coordination with the Thai MOOC team to align with platform dynamics. Activity design adaptation: Tailoring activity designs to meet the needs of hearing-impaired learners, including the use of True/False tests and shorter digital media content.
04 Prototype	The prototype was tested within the assessment framework of the Thai MOOC system, using the testing system (Sandbox studio). The course design adheres to the established Thai MOOC standards. Furthermore, the digital media content produced for this course was uploaded to a dedicated YouTube channel and then integrated into the Thai MOOC platform to enhance the learning experience, as illustrated in Figure 2.  **Figure 2: Screenshot of online media as a digital citizenship course**
05 Evaluate	Assessing digital media quality and formulating online instructional approaches for hearing impaired learners, conduct an evaluation of the caliber of digital media content and the formulation of online pedagogical strategies designed specifically for hearing-impaired individuals. The evaluation process involves the input of five subject matter experts. This panel comprises two experts in hearing-impaired education, two specialists in educational technology, and one authority in curriculum development and teaching methodologies. To assess the suitability of digital media and online learning activities, the outcomes of the suitability assessment were evaluated by calculating their mean ($\bar{x}$) and standard deviation (SD). The means were interpreted using a five-point Likert scale, which ranged from 'Most suitable' (average 4.50 – 5.00) to 'Not suitable / Needs improvement' (average 1.00 – 1.49). A suitability acceptance threshold was set, requiring a minimum average score of 3.50 in each dimension to meet the standard. This benchmark ensures that every aspect of the media and activities achieves a commendable level of suitability.
06 Implementation	This phase involves the seamless inclusion of the course within the operational Thai MOOC platform, ensuring accessibility for hearing-impaired learners. The online scheduling of the course emphasizes educating participants about online media as a facet of digital citizenship. Moreover, a thorough assessment of learning outcomes was conducted with a sample group of 20 learners to measure their

Stages	Implementation
	achievements. This evaluation adheres to the standards and requirements set by the Thai MOOC framework.

The harmonious blend of key elements within the MOOC-based design thinking model. These components include involving hearing-impaired individuals and stakeholders, using Instructional strategies customized for their needs, applying universal design for learning principles, and integrating MOOC as a sophisticated learning tool. This combination results in a unified and comprehensive model as illustrated in table 2 below.

Table 2: The implementation of four Co-Components of the MOOC-Based Design Thinking Model

Co-Components	Implementation
Participation of the hearing-impaired and Stakeholders	The course development for Thai MOOC has enlisted a dedicated team, encompassing renowned deaf actors, skilled sign language interpreters, and proficient educators. Additionally, a production team with extensive expertise in crafting television content tailored for the hearing impaired has been assembled. This collaborative approach aims to ensure the creation of highly relevant and effective course materials that cater to the diverse needs of the student audience.
Instructional Strategies for hearing-impaired learners	Designing effective content and online learning activities for the hearing-impaired learners by emphasis on sign language Integration with real-time closed captioning and streamlined content development for enhanced comprehension. In the context of online assessment creation, the approach entails crafting questions in a True/False format, supplemented by embedded video clips featuring sign language accompanied by real-time closed captioning for all queries. Moreover, the involvement of hearing-impaired actors is leveraged to foster a sense of trust and authenticity in communication.
UDL for hearing-impaired learners	The guiding principles for designing courses and digital media for hearing-impaired learners, aligned with Thai MOOC standards, and integrated with the MOOC-based design thinking model: Use captions and subtitles for audio. Include visuals to support text and audio. Offer transcripts and text versions of videos. Provide sign language interpretation in videos. Incorporate interactive elements for engagement. These principles serve as a blueprint for creating tailored courses using UDL exclusively for this group of learners.
MOOC (Learning Technology)	According to the course development framework on Thai MOOC platform, the researchers examined the procedural intricacies involved in curricular development within the Thai MOOC system, specifically addressing the needs of hearing-impaired learners. The sequence of activities encompassed the following key steps: Seeking authorization within Thai MOOC: Initially, permission was sought from Rangsit University to create a course in the Thai MOOC system, following the standard "Create a new course" procedure. Crafting MOOC course components: Adhering to instructional material design standards, a thorough approach was taken. This included compiling ten key components: course code, content structure, expert content review, learning media integration, learning activity design, assessment and evaluation methods, course information provision, examination strategy, assessment instruments, and certification documentation. Ensuring copyright compliance: To meet copyright regulations, a systematic investigation was conducted to secure multimedia licenses under Creative Commons licenses, primarily (CC BY NC SA), addressing copyright issues. Assessing learning media development: High-quality video content with clear captions was a priority, promoting autonomous student learning. Reviewing learning activity guidelines: Detailed guidelines for effective learning activities were explored, including content comprehension, interactive learning, and discussion forums for student engagement. Examining learning outcome evaluation: Methods for assessing learning outcomes were studied, involving pre-test, chapter quizzes, and post-test with a defined passing score.

3.2 Evaluating Learners on the Thai MOOC Platform

3.2.1 Research instruments and data analysis

Assessment of learning achievement test consistency: The evaluation of the learning achievement test was conducted by comparing the learning achievement test with the learning content and activity plan, utilizing a panel of five experts, and applying the Index of Congruence (IOC). Each question in the test used had a congruence value meeting the criterion (with the IOC value ranging between 0.50 -1.00).

The learning outcome was assessed through true/false questions in both chapter quizzes and the final test assessments, which were conducted within three hours of studying on the Thai MOOC platform. Initially, learners completed a pre-test consisting of 20 questions (with scores not counted). Subsequently, they completed five chapters, each followed by a test comprising five questions, totaling 25 questions with scores recorded. After completing the lessons, learners undertook a final test with 20 questions. To qualify for a certificate from the Thai MOOC, learners needed to achieve a cumulative score of over 70 points from both the chapter quizzes and the final test.

To study learning achievement, the learning outcome—comprising the combined score of the chapter quizzes and the final test—serves as a reference value for the post-test score. This score is then compared to the pre-test score, with both scores normalized to a scale of 100 points for comparison.

3.2.2 Participants

This phase of the study involved the selection of a targeted sample group using a purposive sampling method. The participants comprised students with hearing impairments enrolled at Sethsathien School, an institution located in Bangkok that caters to deaf and hearing-impaired learners. The sample was specifically drawn from students in grade 8-10 levels, a total of 20 individuals.

4. Results

4.1 Expert's Evaluation

Results from experts' analysis of the quality of digital media and design of learning activities for Thai MOOC participants in Table 3

Table 3: Finding of analysis on digital media quality and learning strategy formulation

n=5

Items	Assessment		
	Mean	S.D.	Level of Suitability
Suitability of digital media development within the framework of Thai MOOC			
The suitability of digital media content	4.78	0.16	Most suitable
The suitability of design and development techniques, including teaching methods used in digital media for hearing-impaired learners	4.22	0.31	Suitable
The suitability of utilizing digital media for hearing-impaired learners	4.56	0.29	Most suitable
Average	4.52		Most suitable
Assessing the instructional strategy alignment of designed online learning activities for individuals with hearing impairments			
The suitability of the learning activities aligns with the requirements of Thai MOOC	5.00	0.00	Most suitable
The suitability of the learning activities ensures adequate support for the lesson	4.33	0.31	Suitable
The suitability of the learning activities for learners	4.56	0.31	Most suitable
The suitability of the methodology for evaluating learner outcomes	4.56	0.29	Most suitable
Average	4.61		Most suitable
Total Average	**4.56**		Most suitable

The outcomes of a comprehensive assessment, undertaken by a panel of five experts during the evaluation phase of the model, which included specialists in educational contexts for hearing-impaired learners,

educational technology, and digital literacy, offer insights into the suitability of digital media utilized by the "Utilizing Online Media as Digital Citizenship" course. These findings, outlined in Table 3, highlight the effectiveness of media content, with a notable mean score of 4.78 and a standard deviation of 0.16. Similarly, the evaluation of techniques employed in digital media garnered a mean score of 4.22, along with a standard deviation of 0.31, indicating a satisfactory level of proficiency. Furthermore, the assessment of media suitability for the intended audience revealed a significant mean score of 4.56, accompanied by a standard deviation of 0.29, thus confirming the highest quality of content alignment.

Shifting the focus to the instructional strategies employed for developing online learning experiences tailored to individuals with hearing impairments, the evaluation results affirm the model's validity. The assessment of the alignment of instructional strategies with designed online learning activities for hearing-impaired learners showcased outstanding performance levels. Specifically, the mean score for the suitability of the learning activities in line with the requirements of Thai MOOC reached the highest level at 5.00. Similarly, the evaluation results for the adequacy of support provided by the learning activities for the lesson were robust, with a mean score of 4.33 and a standard deviation of 0.31. The effectiveness of the learning activities for hearing-impaired learners also demonstrated high proficiency, with a mean score of 4.56 and a standard deviation of 0.31. Notably, the suitability of the methodology for evaluating learner outcomes achieved a mean score of 4.56, supported by a standard deviation of 0.29, indicating a high level of accomplishment.

4.2 Learning Outcomes of Hearing-Impaired Learners

The learning achievement of 20 high school students with hearing impairment, who comprised the experimental group in the "Utilizing Online Media as Digital Citizenship" course, was examined. Research findings revealed that when converted to a scale of 100 points, the average score on the pre-test was 68.55 points. The average score on the post-test (chapter quizzes and final test) was 72.05 points. Out of these students, 15 individuals passed the test, accounting for 75 %, while 5 students did not pass (scoring below 70 points according to the Thai MOOC criteria), representing 25 %. The results indicated that the average post-test scores were higher than the pre-test. The scores of each learner were arranged in ascending order based on their pre-test scores, with the post-test scores also included, as illustrated in Figure 3.

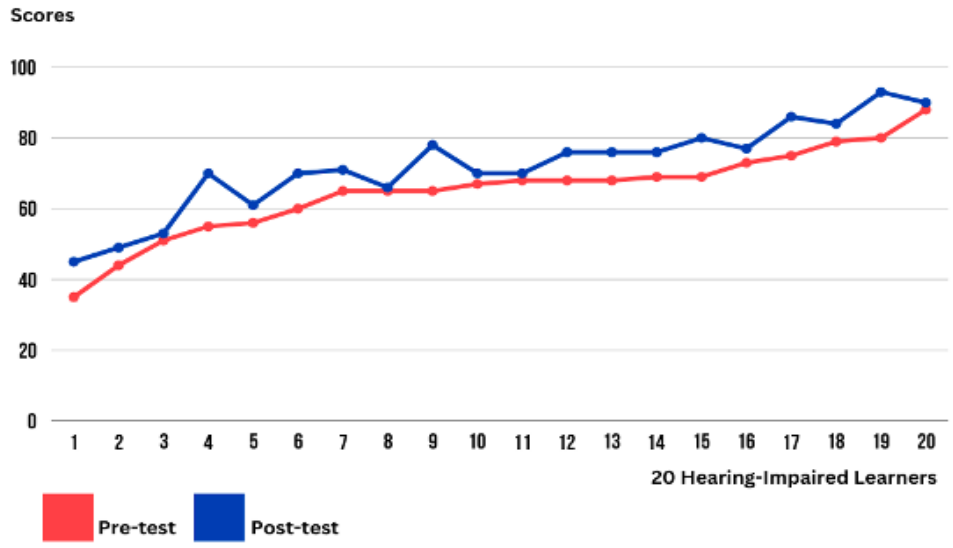

Figure 3: Illustration of the learning achievement of the hearing-impaired learners

5. Discussion

This study has embarked upon the development of a curriculum segment within the MOOC framework, with a primary focus on catering to the educational requirements of hearing-impaired learners. This particular module, titled "Utilizing Online Media as Digital Citizenship Course," has been meticulously crafted utilizing the MOOC-Based Design Thinking Model (Dhamanitayakul et al., 2023). The application of this model in developing digital media has been smooth, encountering no issues. Furthermore, there has been no prior development of learning media specifically for the hearing impaired on Thai MOOC, and adopting this model as a roadmap for development has resulted in high-quality media that yield tangible results for hearing-impaired individuals. The

standout feature of this model lies in its utilization of Thai MOOC, which offers benefits such as accessible, flexible, and cost-effective online education across a wide range of subjects, promoting lifelong learning and skill development for learners worldwide. Additionally, integrating the design thinking model has further enhanced the effectiveness of the curriculum, particularly in catering to the needs of hearing-impaired learners. The research findings indicate that learners achieved higher post-study scores than pre-study scores and passed the Thai MOOC criteria with a success rate of up to 75%, thus confirming the model's efficacy. This aligns with the research of Mingsiritham and Chanyawudhiwan (2020), who experimented with online learning resources on MOOCs to develop life skills for hearing-impaired students and found significant improvements in academic achievement scores and high overall student satisfaction. Moreover, it resonates with de Sá Escudeiro and Campos (2023), who studied the use of MOOCs paired with automatic sign language translation technology and found positive impacts on the learning outcomes of deaf students. Additionally, the digital media developed within this model framework is highly suitable for hearing-impaired learners, a benefit derived from integrating design thinking principles. This is consistent with the research of Suzianti and Atthousi (2019), which employed a design thinking approach to design learning support tools tailored to the needs and desires of deaf elementary students. The testing phase demonstrated significant improvements in visual receptive and expressive language comprehension, indicating the effectiveness of the teaching aids designed using the design thinking approach in enhancing the learning quality for hearing-impaired elementary school students by their needs and desires, as validated by stakeholders.

Additionally, the results of evaluating the suitability of techniques employed in digital media, including the assessment of instructional strategic alignment in the design of online learning activities targeting individuals with hearing impairments, have been deemed highly appropriate, aligning closely with the findings of Ahmed et al. (2022). This alignment underscores the platform's inherent capability to facilitate distance learning, particularly through the provision of educational content complemented by sign language translation videos. Consistent with the research of Mingsiritham and Chanyawudhiwan (2017), it has been established that purely text-based media tends to result in limited comprehension. Multimedia formats, comprising text, images, and sign language, prove to be more effective in enhancing content understanding compared to media containing only text or text combined with sign language, thus meeting the remote learning needs of deaf or hearing-impaired learners. This perspective is supported by the observations of Almalhy (2022), where the effectiveness of video tutorials featuring declarative content and captions was notably evident.

The study sheds light on the complex interactions between deaf or hearing-impaired learners and online technology, emphasizing the inherent challenges of online distance learning, which necessitates the establishment of additional communication channels. Moreover, it acknowledges the cultivation of technological proficiency and adaptability skills among hearing-impaired learners. The academic achievements of hearing-impaired learners emphasize their strong understanding of online media concepts, particularly when media utilize a combination of images and text to enhance engagement and align with learning objectives. These accomplishments reflect an improved ability to effectively utilize online media while also developing a heightened awareness of associated risks. Enhancing online media literacy and digital citizenship is crucial for distinguishing between reality and the digital representation of the world, especially for deaf and hard-of-hearing students. Aligning with the research of Potter, M., Vivienne, S. and Thomas, P. (2014) and Ohler (2011), emphasizing the importance of framing digital education to assist the digitally native generation with disabilities in balancing personal empowerment through digital technology usage and fostering a sense of responsibility towards themselves, their communities, and the world.

6. Conclusions

In conclusion, this research marks a significant stride towards fostering inclusive education and cultivating digital citizenship among hearing-impaired learners through the development of a customized Thai MOOC course. The methodical, three-phase approach ensured the creation of a top-tier course tailored to the unique needs of this demographic. The success of this endeavor underscores the critical importance of providing accessible and inclusive educational opportunities for individuals with hearing impairments. By seamlessly integrating digital citizenship principles into an online learning format, the developed MOOC course equips learners with indispensable knowledge and skills essential for thriving in the digital landscape.

This study's favorable outcomes offer a beacon of inspiration for educators, policymakers, and researchers alike, encouraging them to explore and adopt similar strategies in crafting bespoke courses for other marginalized groups. Throughout the experimental phase, involving 20 hearing-impaired learners, the course's efficacy was meticulously evaluated, yielding impressive results. Notably, the course received exceptional ratings for digital

media quality and learning activity design, reaffirming the effectiveness of the course development process. Additionally, the learner's exam scores surpassed the pass threshold, reflecting a commendable 75% pass rate and affirming the course's capacity to elevate learning outcomes for hearing-impaired individuals.

Nevertheless, the success of the Thai MOOC course for hearing-impaired learners underscores the transformative potential of integrating digital citizenship education into online learning frameworks. It stands as a testament to the power of inclusive pedagogy and educational technology in creating a more equitable, empowering, and digitally literate society.

Future research should delve into the efficacy of similar tailored MOOC courses, developed using the model employed in this study, for other groups with hearing impairments. This exploration could yield valuable insights into promoting inclusive education on digital platforms. Moreover, investigating the scalability and sustainability of such courses across diverse educational contexts and regions could enhance understanding and implementation strategies. Efforts to mitigate limitations should include expanding sample sizes, integrating qualitative data collection methods, and exploring alternative statistical approaches.

7. Limitations of the Study

The current study encompasses limitations that warrant acknowledgment 1) limited sample size, The study's sample size was constrained due to the specific demographic of hearing-impaired students within audio-visual educational schools. These institutions typically maintain a class size cap of limit at 10 students per class, comprising a heterogeneous group that may include individuals with autism and dual auditory challenges. This unique composition posed challenges in managing the sample for experimental purposes; 2) simplistic statistical approaches, the research opted for straightforward statistical methods to gauge academic attainment. This choice arose from aligning with established requisites, guidelines, and performance standards pertinent to authentic online instructional delivery and management evaluations on the Thai MOOC platform. Evaluation centered on achievement benchmarks derived from chapter quizzes and final tests combined to be 100 assessment points. Successful completion, entailing the attainment of scores exceeding 70 points, was a prerequisite for certification.

8. Protection of Participants' Rights

The researchers ensured the protection of participants' rights by receiving authorization from the chair of the human research ethics committee at Rangsit University to gather research data. The research received official approval with certification number COA. No. RSUERB2022-099, effective as of September 22, 2022. Adhering to the principles stated in the Declaration of Helsinki, the Belmont Report, the CIOMS Guidelines, and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP), the researcher communicated the study's objectives and data collection procedures to the participants before collecting research data. Furthermore, participants were informed that their identities would remain confidential, and the research outcomes would be treated with confidentiality, exclusively for academic purposes.

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Operationalizing a Weighted Performance Scoring Model for Sustainable e-Learning in Medical Education: Insights from Expert Judgement

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Abstract: Validation is needed for any newly developed model or framework because it requires several real-life applications. The investment made into e-learning in medical education is daunting, as is the expectation for a positive return on investment. The medical education domain requires data-wise implementation of e-learning as the debate continues about the fitness of e-learning in medical education. The domain seldom employs frameworks or models to evaluate students' performance in e-learning contexts. However, when utilized, the Kirkpatrick evaluation model is a common choice. This model has faced significant criticism for its failure to incorporate constructs that assess technology and its influence on learning. This paper aims to assess the efficiency of a model developed to determine the effectiveness of e-learning in medical education, specifically targeting student performance. The model was validated through Delphi-based Expert Judgement Techniques (EJT), and Cronbach's alpha was used to determine the reliability of the proposed model. Simple Correspondence Analysis (SCA) was used to measure if stability is reached among experts. Fourteen experts, professors, senior lecturers, and researchers with an average of 12 years of experience in designing and evaluating students' performance in e-learning in medical education participated in the evaluation of the model based on two rounds of questionnaires developed to operationalize the constructs of the model. During the first round, the model had 64 % agreement from all experts; however, 100% agreement was achieved after the second round, with all statements achieving an average of 52% strong agreement and 48% agreement from all 14 experts; the evaluation dimension had the most substantial agreements, next to the design dimension. The results suggest that the model is valid and may be applied as Key Performance Metrics when designing and evaluating e-learning courses in medical education.

Keywords: E-learning evaluation model, Medical education, Content validation, Performance optimization, Expert judgment technique

1. Introduction

E-learning is a comprehensive concept encompassing the asynchronous or synchronous dissemination of knowledge to learners via electronic systems (Güllü, Kara and Akgün, 2024). Recently, e-learning has garnered significant recognition as a mainstream approach in health sciences education (HSE), encompassing medical, dental, public health, nursing, and other allied healthcare disciplines. However, there remains considerable debate surrounding the role of e-learning and its impact on learners' performance and learning enhancement (Regmi and Jones, 2020). In medical education, e-learning is a strategic tool for human resource development in health to combat the burden of diseases and ensure the achievement of the United Nations' Sustainable Development Goals (Oluwadele, Singh and Adeliyi, 2023a). Healthcare professionals play a crucial role in offering essential and dependable assistance to individuals with HIV/AIDS and tuberculosis, and e-learning is appraised as a potent strategy to address the challenges of HIV/AIDS and tuberculosis in sub-Saharan African nations (Ajenifuja and Adeliyi, 2022). Despite these potentials, the debate about the suitability of e-learning in medical education is still heated. Scholars argue that although e-learning is being accepted and used in medical education, it might have been used because of its popularity and novelty rather than for pedagogical evidence, and it is difficult to assess its success (Cook, 2007). Khasawneh et al. (2016) assert that e-learning is not a universally effective teaching tool because it requires careful evaluation when incorporated into established curricula and the dire need to assess the impact of e-learning on a case-by-case basis. The recurring, context-specific global difficulties in medical education and the health profession underscore the lack of agreement on the suitability of e-learning in medical education. These difficulties have been defined as wicked problems that

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defy recognized solutions and are perceived differently by different people (Mennin, 2021). Mennin articulated the wicked problems as the effect of the pandemic on the quality of e-learning, the persistent quality concerns in clinical teaching, the enduring resistance to change among faculty members, the intricacies of collaboration, persistent constraints related to time and resources, biases across various dimensions, the intricate balancing act of fulfilling multiple professional and personal roles, the imperative for curriculum integration, pervasive conflicts within health professions institutions, and the perpetual challenge of faculty development. Solving these problems requires pursuing inquiry, pattern recognition, and adaptive action.

Although the COVID-19 pandemic led to the wide adoption of e-learning in medical education, it also created more problems. Despite the ideal approach of developing a well-devised plan, starting with a needs assessment to determine system requirements and usage (Khasawneh et al., 2016), many universities have hastily implemented "emergency e-learning" protocols in response to the pandemic, transitioning from traditional face-to-face learning to e-learning (Murphy, 2020). This unprepared shift has compelled students accustomed to conventional learning into e-learning, a situation referred to as an "imperfect yet quick solution to the crises" with potential repercussions on student performance (Nagar, 2020). The repercussion of this is that although publications on the implementation of e-learning in medical education have sporadically increased since the onset of the pandemic (Oluwadele, Singh and Adeliyi, 2023b), there is a lack of standardization in the evaluation of e-learning in medical education. Performance evaluation is conducted haphazardly, and authors do not focus on metrics that evaluate the technology components of e-learning – a phenomenon termed "evaluating e-learning minus the e" (Oluwadele, Singh and Adeliyi, 2023b), meaning that the learning component of e-learning is being evaluated with little emphasis on the electronic component. Researchers rarely used a performance evaluation framework to guide their evaluation process, and a few used the Kirkpatrick evaluation model, a widely criticized model for its inflexibility in evaluating technology-enabled learning. E-learning evaluation frameworks provide researchers with specific concepts to measure and structures to assess how well e-learning has been implemented. They assist in directing the implementation process and aid in the identification of potential facilitators and inhibitors that need to be addressed.

E-learning implementations are labor- and resource-intensive (Farhan, Talib and Mohammed, 2019); hence, there is a need to rigorously evaluate e-learning implementation to establish its importance, quality, and acceptance, as this gives investors confidence for continued investment and expansion of e-learning implementation (Raspopovic et al., 2014). One of the challenges of e-learning evaluation is the choice of performance criteria to evaluate and ascertain its impact. A solution to this challenge is to develop a systematic e-learning assessment model from the study of existing e-learning models and systems to improve the performance and use of e-learning techniques (Farhan, Talib and Mohammed, 2019, Raspopovic et al., 2014). Various dimensions of e-learning require evaluation; these include educational, personal, institutional, cultural, and technical dimensions, to mention a few. Although all these dimensions are crucial for effective e-learning implementation, this study focuses on the evaluation of e-learning in medical education from a student performance perspective.

This study aims to assess the efficiency of a model developed to determine the effectiveness of e-learning in medical education, specifically targeting student performance using expert judgment techniques. The first section of this study introduces the study by problematizing it based on extant literature. This is followed by Section 2, which delineates the materials and methodology, detailing the appropriateness of the Delphi technique design of our expert judgment method. Subsequently, section 3 encapsulates the outcomes of the conducted process, and ultimately, Section 4 formulates the primary conclusions of the paper, along with recommendations for future research directions.

2. Materials and Methods

This section presents the research questions that informed the research approach for this study and why and how the Delphi method was used to achieve consensus. This study seeks to answer the main research question: "How do experts perceive the efficacy of the weighted performance scoring model for designing and evaluating students' performance in e-learning contexts in medical education? The research questions proposed to drive the study are shown in Table 1:

Table 1: The research questions that drive the study

	Research Question	Purpose
RQ1	To what extent does the model guarantee the design of e-learning courses for optimal student performance in medical education?	This research question explores the model's reliability for designing e-learning courses that students find usable, useful, fit for context, learnable, and valuable.
RQ2	To what extent does the model ensure the evaluation of e-learning courses specifically focusing on students' performance in e-learning in medical education?	This research question explores the model's reliability for evaluating e-learning courses with a specific focus on how satisfied students felt with the course if they acquired knowledge and could apply it to solve problems in real-life scenarios.
RQ3	Does the model provide a coherent approach to designing e-learning courses?	This question presents the gap identified by experts that need to be explored further in research.

2.1 Overview of the Delphi Technique

Expert judgment techniques involve enabling a group of experts within a specific knowledge domain to provide their opinions on a particular subject collectively (Jagatheesan, 2022). Utilizing expert judgment as an assessment approach presents numerous benefits, including the superior quality of judgments provided by experts and the potential to acquire comprehensive information on the subject matter (Almenara and Cejudo, 2013). This process is crucial, as its accurate execution is sometimes the sole indicator of the content validity of a research instrument or consensus (Escobar-Pérez and Cuervo-Martínez, 2008). Various expert judgment techniques are applicable for forecasting, evaluation, or policy design. Some widely recognized techniques include brainstorming, the Nominal Group Technique (NGT), the Delphi method, and didactic interaction.

When brainstorming, the group of experts uses the brainstorming technique to share concepts related to a problem, aiming to diverge from the confines of formal problem-solving sessions to generate many ideas, including groundbreaking ones. Additionally, there is an emphasis on fostering the combination or merging of the suggested ideas (Alonso, 2015). Nominal Group Technique (NGT) involves assembling an expert group to identify problem components, propose potential solutions, and establish priorities. In the NGT approach, experts convene in person and, under the guidance of a facilitator and through a structured process, engage in discussions, voting, and ranking of the elements related to the analyzed problem (Carney, McIntosh and Worth, 1996). The Delphi method involves a panel of experts discussing a chosen topic to achieve consensus. However, in this application, consensus is sought through questionnaires and successive rounds, deliberately preventing experts from mutual identification to mitigate potential group pressures that may arise from direct discussions (Von Der Gracht, 2012). Didactic interaction is typically applied in situations requiring "yes/no" decisions. It involves in-person meetings where the group is divided into two subgroups, each expressing divergent views and engaging in discussions. Subsequently, they switch roles, each group advocating for the opposing position. This exchange facilitates an understanding of each other's perspectives and aids the group in reaching a consensus (Jagatheesan, 2022).

This study aims to conduct content validation of a model that evaluates the performance of e-learning in medical education through expert judgment. The brainstorming technique was unsuitable for the study given that the aim was to seek concession on the quality of the model developed to evaluate performance in e-learning in medical education and not to generate new ideas for a problem. The NTG technique requires experts to convey in person, which was not feasible given the geographic distribution of the experts. The didactic technique was also unsuitable as a yes, or no answer was not required to validate the model; instead, in-depth discussion and triangulation of perspective are necessary to uncover grey areas and propose areas for further improvement. Hence, the Delphi technique is the most suitable for achieving the study's objectives.

The Delphi technique is excellent for eliciting and combining expert judgment. When employing the Delphi technique, the facilitator manages the flow of information among unidentified panelists through multiple iterations, culminating in the average of estimates from the final round serving as the group's collective judgment. This approach is suitable in situations where the application of statistical methods is not fitting, a substantial number of experts are accessible, and the alternatives involve either averaging the forecasts of multiple individuals or employing a conventional group method (Rowe and Wright, 2001). All these situations were related to the context of this study, justifying the choice of expert judgment as the technique of choice.

Expert judgment is characterized by anonymity, iteration, controlled feedback, and statistical group response (Dalkey, Brown and Cochran, 1969, Jagatheesan, 2022). Maintaining anonymity necessitates that panel

members remain unfamiliar with each other to mitigate group pressure. The iteration process mandates multiple rounds until information reaches a point of saturation. Controlled feedback involves structuring the feedback-gathering process under the facilitator's guidance. Statistical group response requires the facilitator to furnish experts with a report incorporating statistical processing of panelists' opinions, comments, mean, median, and standard deviation. This feedback serves as a feedforward for the subsequent iteration.

Hsu and Sandford (2007) Suggest distinct stages (Figure 1) and drawbacks associated with the Delphi method, encompassing the risk of reduced response rates, extensive time commitments, and the susceptibility to influencing opinions.

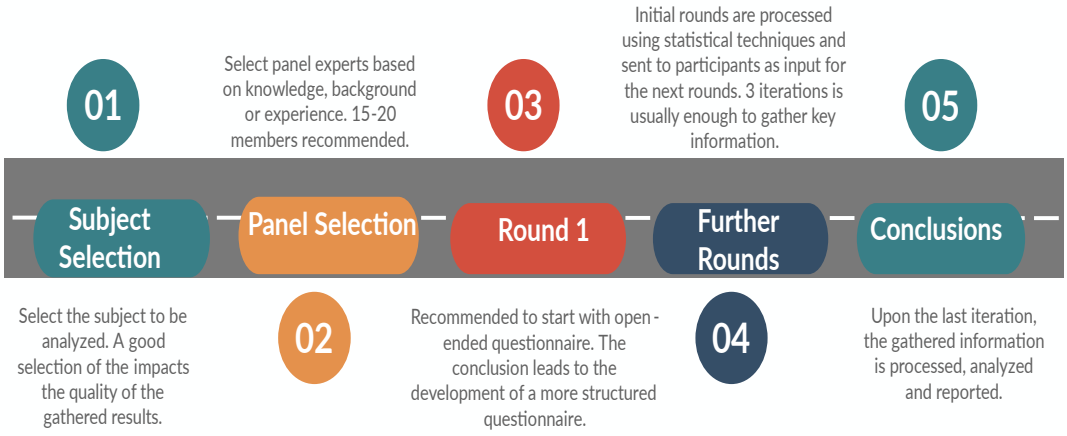

Figure 1: Delphi method overview

Consensus and stability are other vital concepts researchers must consider when using the Delphi method to aggregate expert opinions on future developments and incidents (Von Der Gracht, 2012). Consensus denotes the alignment of opinions toward a specific value, while stability signifies the consistency of values across various iterations. Dajani, Sincoff and Talley (1979) Argued that consensus without stability is meaningless and proposed a decision tree (Figure 2) to guide the achievement of consensus and stability. Stability must be assessed after each round, after which consensus can be examined. The two main approaches to examining consensus include qualitative analysis with descriptive statistics and inferential statistics (Gliem and Gliem, 2003). Qualitative analysis with descriptive statistics involves conducting a subjective analysis to identify a particular level of consensus and incorporating measures such as mean, median, and standard deviation to evaluate and attain consensus among panelists. Inferential statistics, on the other hand, involves diverse statistical metrics to explore various relationships among variables. Metrics such as Chi-square, Cohen's kappa, Fleiss' kappa, or Kendall's W can gauge the level of consensus, contingent on the specified scale.

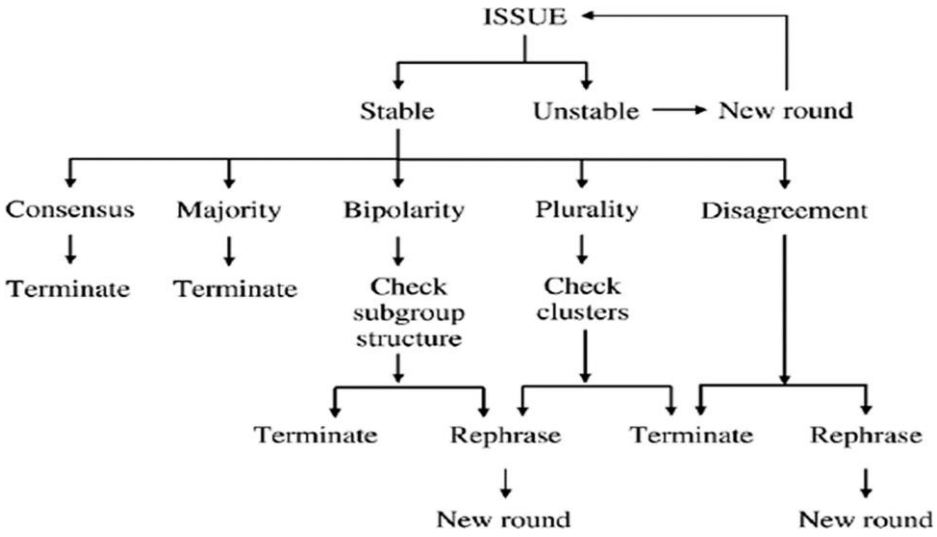

Figure 2: Hierarchical stopping criteria for Delphi methods (DajaniSincoff and Talley, 1979)

2.2 Subject Selection

The first step was to define the subject and design the initial questionnaire. The questionnaire design for the Delphi method involves starting with a well-defined version, clarifying elements in subsequent rounds, and using statistical techniques for ongoing reliability assurance. When formulating a questionnaire for the Delphi method, two acceptable approaches include either utilizing the first round to refine the questionnaire or commencing the first round with an already well-defined version (Hsu and Sandford, 2007). In this study, the latter approach was adopted, given that the elements to be validated were initially clear, though the questionnaire itself may undergo minor modifications based on received feedback. Statistical techniques will be applied throughout the process to maintain reliability.

This study aims to evaluate the Weighted performance Scoring model as a coherent framework that could guarantee the design and evaluation of e-learning courses optimized for student performance in medical education. Therefore, the panel of experts will evaluate three dimensions – first is the extent to which the model guarantees the design of e-learning courses for optimal student performance, and the second is the extent to which the model ensures the evaluation of e-learning courses with a specific focus on students performance in e-learning in medical education. Lastly, the internal coherence of the model is assessed to establish its completeness, coherence, and the presence of conflicting constructs and proposals for further improvement. Hence, the questionnaire is divided into three sections to ensure that each dimension is independent – meaning that the model can help evaluate but not design e-learning courses in medical education or the other way around. Table 2 presents the statements to assess each of the proposed dimensions of the weighted performance scoring model. The design dimension used the user interface and user experience evaluation framework for STEM education (Alomari et al., 2020) to inform the course of inquiry, while the Kirkpatrick evaluation model (Kirkpatrick, 1959) was used to structure questions relative to the evaluation dimension.

Table 2: Proposed statements to assess design, evaluation, and fitness dimensions of the weighted scoring model

ID	Dimension	Statement	Rationale
Q1	Design (UI/UX)	The proposed model helps design an e-learning course that is easy for students to use.	This statement assesses the usability of the online learning environment.
Q2		The proposed model helps to design an e-learning course that satisfies the students' learning needs.	This statement assesses the usefulness of the online learning environment.
Q3		The proposed model helps design an e-learning course that fits the context.	This statement assesses the context of the online learning environment.
Q4		The proposed model helps design an e-learning course that is valuable to students.	This statement assesses the value proposition of the e-learning course to the users.
Q5		The proposed model helps design an e-learning course that uses technology to enhance learning.	This statement assesses how users learn with technology and how technology can facilitate learning.
Q6	Evaluation	The proposed model helps evaluate students' reactions to the e-learning course.	This statement assesses how users felt about the e-learning course.
Q7		The proposed model helps to evaluate how students learned from the e-learning course.	This statement assesses how users acquire knowledge from the e-learning course.
Q8		The proposed model helps to evaluate how students applied what was learned from the e-learning course.	This statement assesses how users applied the acquired knowledge from the e-learning course in a clinical setting.
Q9		The proposed model helps evaluate the benefits of applied knowledge acquired from the e-learning course.	This statement assesses how users applied the acquired knowledge from the e-learning course in a clinical setting.
Q10	Fitness	The model provides a coherent approach to designing e-learning courses in medical education.	This statement measures the effectiveness of the proposed model for e-learning course design in medical education.
Q11		The model provides a coherent approach to evaluating e-learning courses in medical education.	This statement measures the effectiveness of the proposed model for e-learning course evaluation in medical education.

A Likert survey was given to the panel to rate the statements. The scale categorizes responses from "Strongly disagree" (1) to "Strongly agree" (5), allowing individuals to express their agreement or disagreement with a given statement on a continuum. The study employed a unified questionnaire distributed through Google Forms to gather opinions and demographic information from panel members while ensuring their anonymity. The communication and reporting processes maintained strict confidentiality by keeping the panel composition undisclosed and anonymizing results to protect participants' identities.

2.3 Statistical Processing

The analysis employs descriptive statistics, including mean, median, standard deviation, and percentage of agreement and disagreement, to assess experts' consensus on proposed statements, offering an overview of the panel's overall opinion on the framework. Cronbach's alpha is utilized to gauge the reliability of the questionnaire (Cronbach, 1951), examining how the measurement instrument adapts to evaluated magnitudes and how amendments to the questionnaire can impact its reliability across different process rounds. The formula for calculating Cronbach's alpha, denoted as α, is as follows:

$$\alpha = k \times \bar{r} \,/\, 1+(k-1)\times \bar{r} \qquad (1)$$

Where k is the number of items in the test or scale, and $\bar{r}$ is the average of all possible split-half coefficients. The Cronbach alpha reliability interpretation scale categorizes reliability levels as follows: an alpha greater than 0.9 is considered excellent, between 0.9 and 0.8 is deemed good, 0.8 to 0.7 is acceptable, 0.7 to 0.6 is questionable, 0.6 to 0.5 is poor, and an alpha below 0.5 is deemed unacceptable (George, 2011). Simple Correspondence Analysis (SCA) reduces the dimensionality of a matrix while representing the matrix with a two or three-dimensional space for visualization purposes (Nenadic and Greenacre, 2007). SCA calculates the homogeneity of experts' ratings and questions, rates, and tracks how this homogeneity evolves through process rounds, determining whether consensus is achieved among experts. A short distance between ratings or statements implies consensus and homogeneous expert behavior.

2.4 Panel Selection

The literature does not provide standardized recommendations regarding the ideal number and members' profiles in a Delphi method expert panel, as these variables are context-dependent. In our study, experts were selected based on specific criteria to ensure their expertise and relevance to the topic of e-learning in medical education. The criteria included having at least ten years of experience designing and evaluating e-learning courses and programs in medical education. This ensured that the selected experts deeply understood the subject matter and could provide valuable insights during the Delphi study. A total of twenty experts were initially invited to participate in the survey on the 7th of August, 2023. These experts were identified through academic literature, professional associations, and recommendations from other experts in the field. However, only 14 experts responded positively and actively participated in all iterations of the Delphi study. The expert panel consisted of individuals with varying years of experience in designing and evaluating e-learning in medical education. This diversity in experience ensured that the panel represented a wide range of perspectives and insights into the topic.

The Delphi study was conducted in two rounds, each spaced eight weeks apart. In each round, experts were asked to review and provide feedback on statements related to e-learning in medical education. They were also asked to rate their level of agreement with each statement on a scale of 1 to 5. The data collection method involved emailing survey links to the experts on Google Forms. The experts were given a specified period to complete the survey and submit their responses. The process of selecting experts and conducting the Delphi study was carefully designed to ensure the validity and reliability of the results. Figure 3 shows the experiences of experts in designing and evaluating e-learning courses in medical education. The panel members have 12.7 years of experience in designing and 12.4 years in evaluating e-learning courses in medical education.

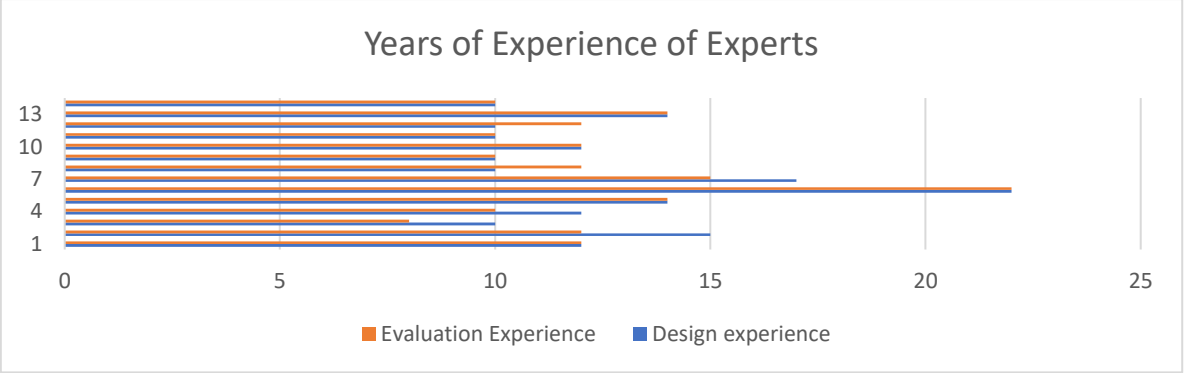

Figure 3: Years of experience of experts

Figure 4 shows the types of organizations of the experts. 86% of the experts work in universities, while 7% work in private organizations and research institutions. Figure 5 shows the work profile of the experts. 50% are professors, 36% are senior lecturers, and 14% are researchers.

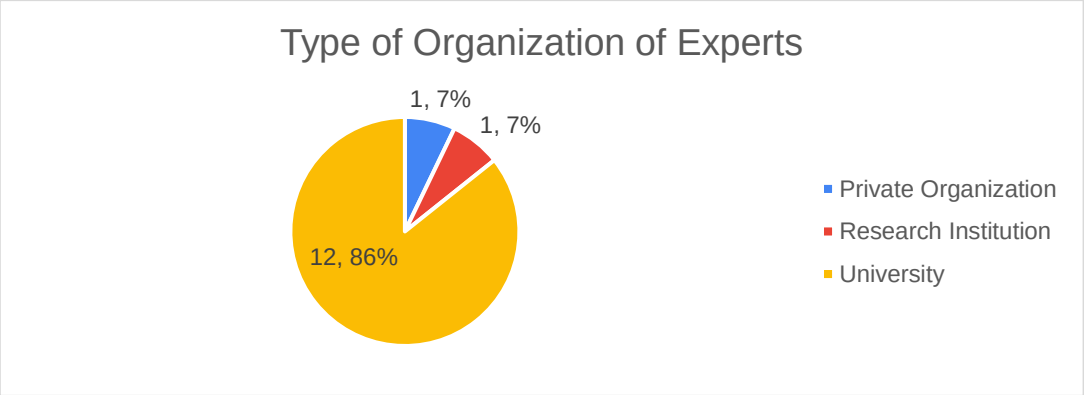

Figure 4: Type of organizations of experts

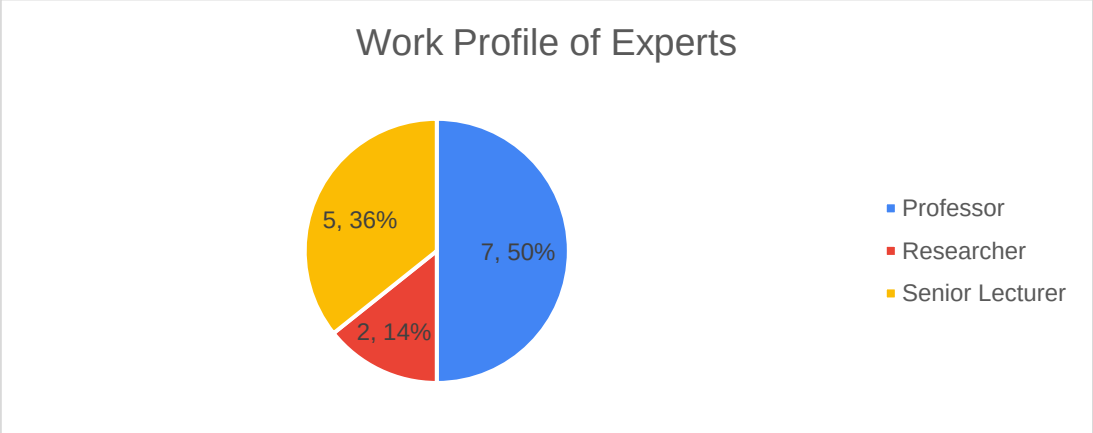

Figure 5: Work profiles of experts

3. Results

3.1 First Round

The first round of the Delphi method was conducted on the 7th of August, 2023, and finished on the 30th of August, 2023. Twenty invitations were sent via email, and only 14 responses were received. Table 3 summarizes the collective results of the phase, including average assessments, medians, standard deviations, and the percentage of agreement and disagreement among the 14 experts for each statement.

Table 3: Collective results for the first round

Dimension	Statement	Average	Median	Standard Deviation	% Agreement	% Disagreement	No opinion
Design	Q1	4.14	4.00	0.52	93	0	7
	Q2	3.57	3.50	0.62	50	0	50
	Q3	3.50	3.00	0.73	36	0	64
	Q4	4.14	4.00	0.52	93	0	7
	Q5	4.21	4.00	0.56	93	0	7
Evaluation	Q6	4.07	4.00	0.46	93	0	7
	Q7	3.86	4.00	0.52	79	0	21
	Q8	3.36	3.00	0.48	36	0	64
	Q9	3.36	3.00	0.48	36	0	64
Fitness	Q10	3.43	3.00	0.49	43	0	57
	Q11	3.57	4.00	0.49	57	0	43

The descriptive analysis revealed that experts do not express any disagreement with the proposed statements as no question received disagreement from all experts. In most statements, the median is 4, indicating that "Agree" is the most frequently chosen value by the raters. However, it's notable that many statements have "Neither agree nor disagree" as the most selected value. The assessment averages show that there is an explicit agreement among experts for seven statements, with values exceeding 3.50. However, four statements exhibit values between 3.50 and 3.36, signaling a lack of consensus. Moreover, the presence of ambiguous answers highlights divergent opinions among experts. After a comprehensive initial descriptive analysis, three primary concerns emerge:

1. Some experts stated that they needed more details concerning the engineering of the model to understand better how the ten constructs were arrived at.
2. Some experts expressed insufficient knowledge to evaluate specific statements, leading them to select Neither agree nor disagree" as a response, signifying a "Don't know/No answer" stance.
3. Other experts highlighted that they could not map each construct of the model to the specific constructs being evaluated in the questionnaire and recommended that a questionnaire be developed to operationalize the measurement of the constructs constituting the model and that the questions on the questionnaire be mapped to the constructs to be evaluated in the next iteration to enhance accuracy in assessment.

Aside from the overall analysis of the questionnaire, the study also performed a detailed descriptive analysis of each dimension. Radar charts were utilized to present the results of each dimension in Figures 6, 7, and 8, while Figure 9 is a visual representation of the experts' agreement for all dimensions using box and whisker graphs.

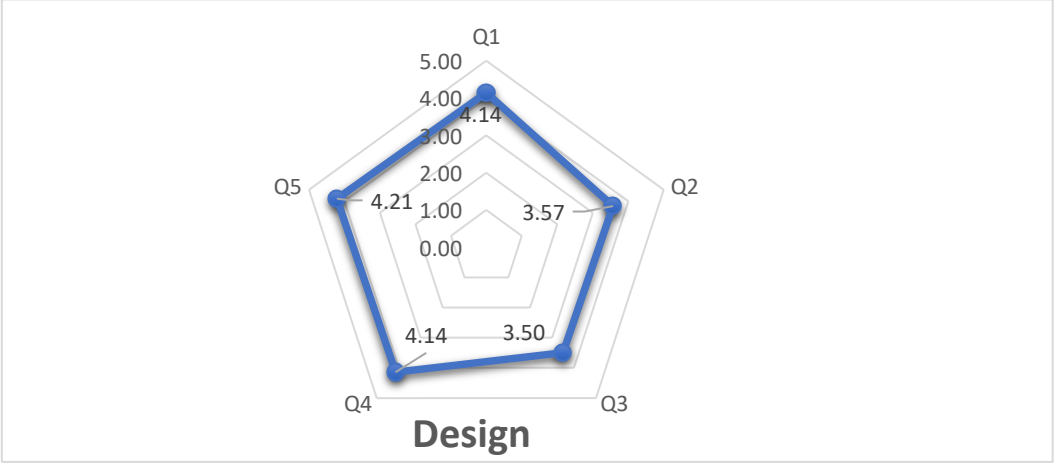

Figure 6: Experts agreement for design dimension

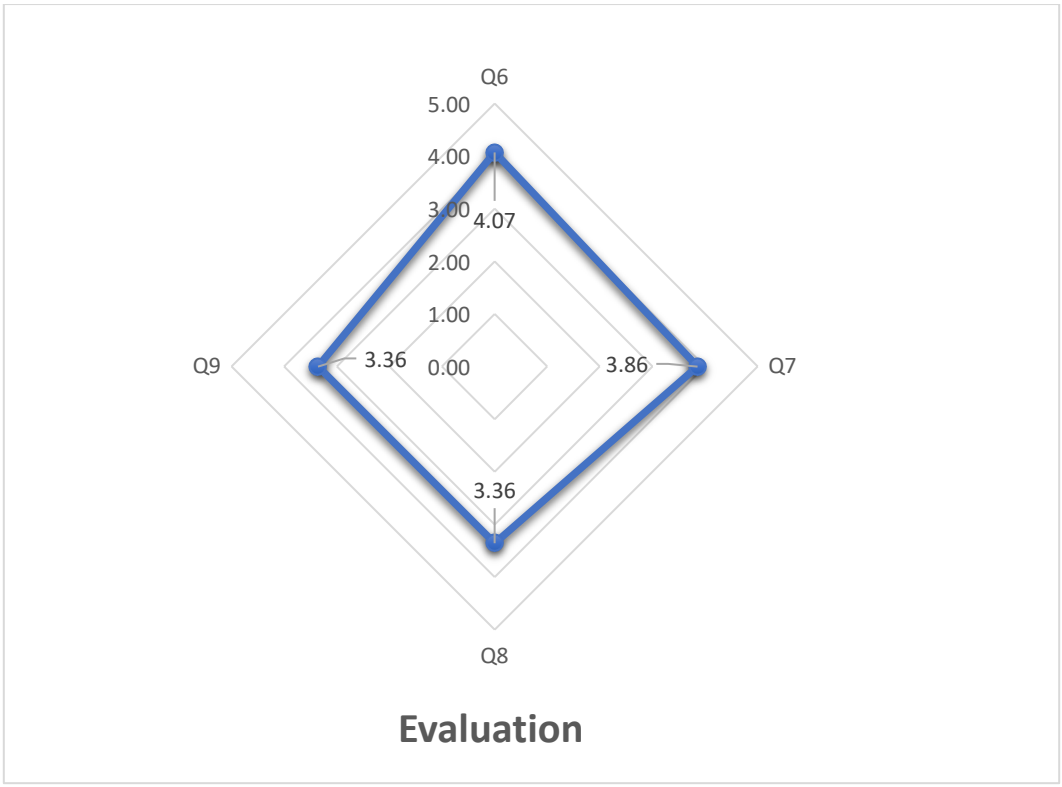

Figure 7: Experts agreement for evaluation dimension

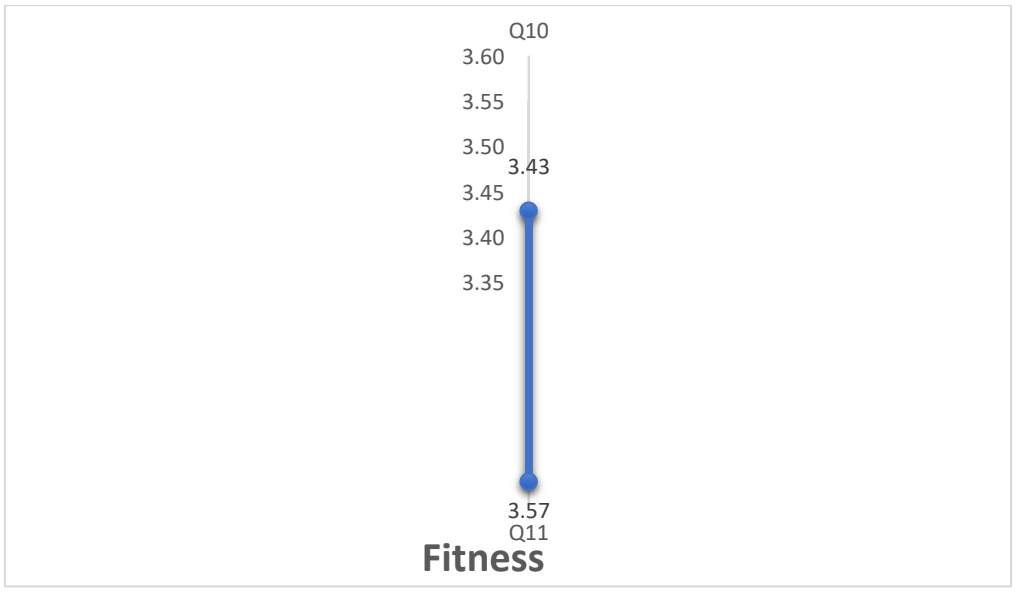

Figure 8: Experts agreement for fitness dimension

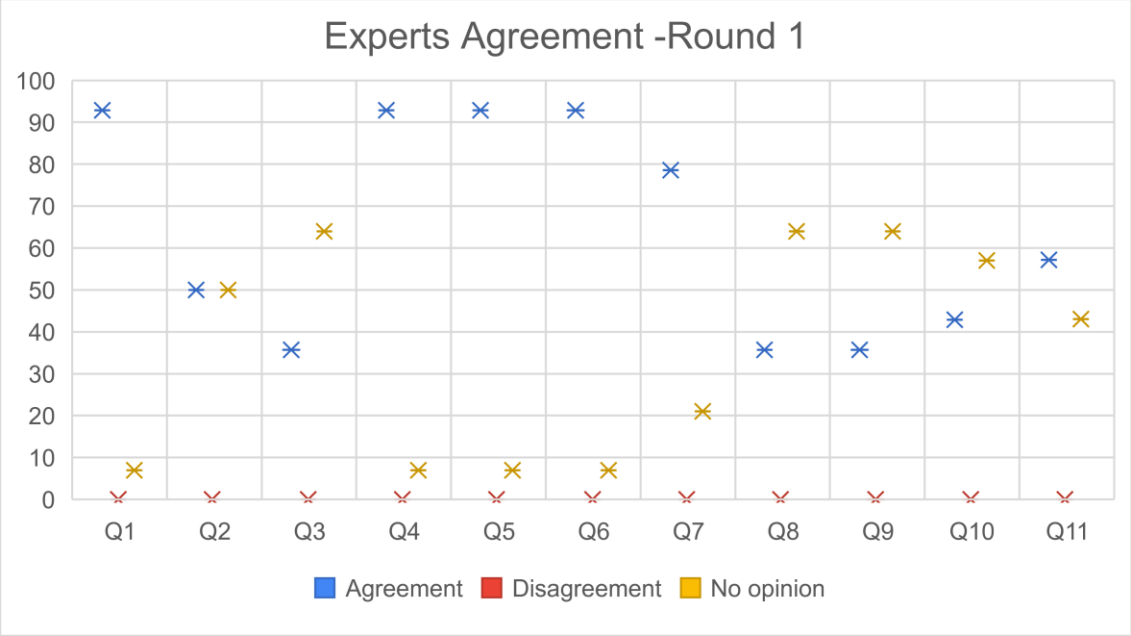

Figure 9: Aggregate of experts' agreement for all statements using box and whiskers graph of the first round

Figures 6 and 9 show that the experts' agreement for the design dimension is high, given that 3 out of 5 statements had agreements of over 90%, the average of all statements in the dimension is 3.91, and the median is 4.14. As reflected in Q2 and Q3, the challenge in this dimension is that experts wanted to understand how learning needs are defined and how the model assists in designing e-learning courses that satisfy students' learning needs. Besides, experts wanted to understand what was meant by context and how the proposed model helps develop an e-learning course that fits the context. Figures 7 and 9 show that experts' agreement for the evaluation dimension was only slightly above average, given that only 25% of the statements had agreements of over 90%, while the average of all statements in the dimension is 3.66, and the median is 3.61. The challenge in this dimension, as reflected in Q8 and Q9, is that experts wanted to understand how the factors in the model can be operationalized to help evaluate how students applied what was learned from the e-learning course and the benefit of the knowledge acquired. Operationalizing the model using questionnaires and mapping factors to the evaluation dimension is crucial for providing clarity in the next round. The fitness dimension was rated comparatively lower than the first two dimensions. Figures 8 and 9 show that experts' agreement for the fitness dimension was average, given that no statements had agreements of over 90% while the average of all statements in the dimension is 3.50 and the median is 3.50. Most experts neither agreed nor disagreed with the statements examining if the model provides a coherent approach to designing and evaluating e-learning courses in medical education. This is not surprising, given the concerns expressed by experts regarding the design and evaluation dimensions.

Homogeneity and concordance analysis

The analysis of homogeneity and concordance followed the descriptive examination to assess reliability. The calculation of Cronbach's alpha was performed on R using two packages, psy and psych, for triangulation and confirmability. This gave a result:

$\alpha = 0.83$ on both packages.

According to George (2011), this value implies good reliability and demonstrates a high internal consistency of the proposed questionnaire. In conclusion of the round, Simple Correspondence Analysis (SCA) was conducted for the entire questionnaire using the R package "ca" and FactoMineR, and the results obtained are depicted in Figure 10. This analysis aimed to visualize the relationships within the comprehensive questionnaire dataset. As illustrated in Figure 11, most experts and statements (except a few experts like experts 2 and 9) are clustered around the central point, signifying a homogeneous perspective among most experts. This outcome is further emphasized when examining the statements that exhibit clustering, with design statements being outliers. In summary, the test reveals a notable level of consensus among experts, indicating a degree of homogeneity in the assessments provided.

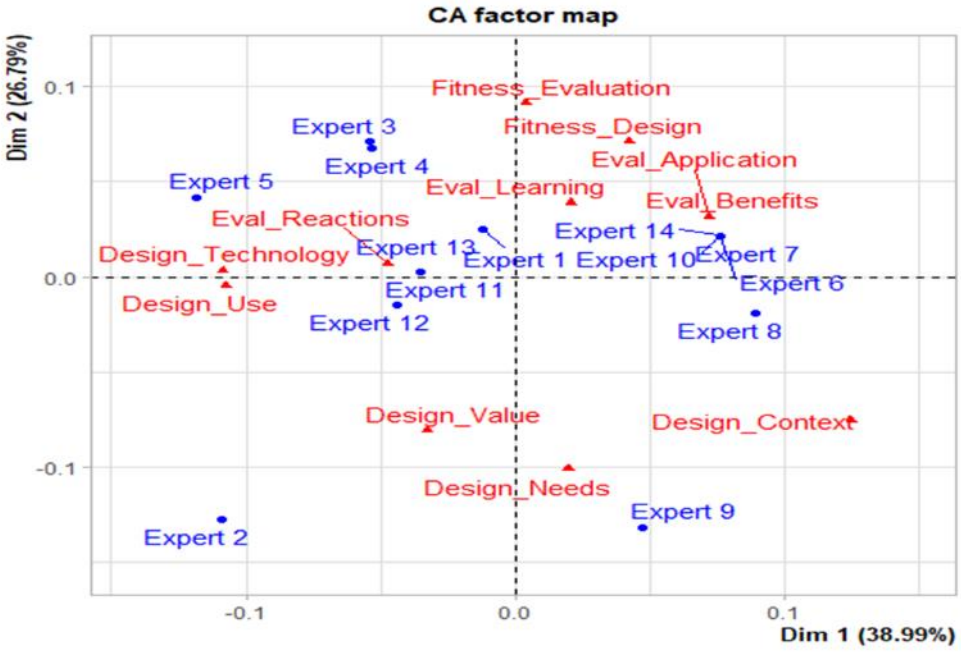

Figure 10: Simple Correspondence analysis of experts' opinions and statements

Round conclusions

The descriptive, homogeneity, and concordance analysis reveal that, while the proposed model demonstrates suitability and a degree of homogeneity in expert responses, the reliability and homogeneity tests affirm that there remain elements requiring improvement and clarification in the experts' opinions. Consequently, a second round of the Delphi method was suggested to the panel. In this round, an anonymized version of the comments and statistical data from Table 3 was provided to the members, the model was operationalized using two types of questionnaires, and modifications were made to the questionnaire based on the feedback received from the experts, as detailed in the next section.

3.2 The Model

The model was developed to standardize e-learning performance evaluation in medical education from the PCA of the factors that constitute the CSF for e-learning in medical education, as shown in Table 4.

Table 4: Correlation and Statistical Significance of Factors used to design the model

Principal Component for Dimension 2 (PC2)	Content Structure	Helpfulness	Appeal	Ease of Navigation	Competence	Interest	Usefulness	Content quality	Suitability	Previous experience
Correlation	8.24E-01	7.05E-01	7.05E-01	6.54E-01	4.54E-01	4.51E-01	4.22E-01	3.43E-01	2.34E-01	2.34E-01
p-value	1.23E-26	9.57E-17	9.57E-17	6.87E-14	1.43E-06	1.78E-06	9.09E-06	3.92E-04	1.72E-02	1.72E-02

Based on these factors' correlation and statistical significance, a system was designed where each dimension contributes to an overall score based on the loading. The performance score for the performance evaluation process or products in e-learning in medical education was calculated using the formula below:

$$P\ Score = \frac{\sum(Correlation\ Weight \times Factor\ Score)}{\sum Correlation\ Weight} \quad (2)$$

Equation 2 is the formula for the weighted performance scoring model. This is further decomposed in Equation 3 by multiplying the correlation weight of each factor by the maximum performance score of each factor.

$$P\ Score = \frac{\begin{array}{c}(0.824 \times \text{Content Structure} + 0.705 \times \text{Helpfulness} + 0.705 \text{ x Appeal} + \\ 0.654 \times \text{Ease of Navigation} + 0.454 \times \text{Competence} + 0.451 \text{ x Interest} + 0.422 \times \text{Usefulness} + \\ 0.343 \times \text{Content Quality} + 0.234 \times \text{Suitability} + 0.234 \times \text{Previous experience})\end{array}}{(0.824+0.705+0.654+0.454+0.451+0.422+0.343+0.234+0.234)} \quad (3)$$

Figure 11 depicts how the weighted scoring model is operationalized to develop various questionnaires to evaluate each factor. The model shows that questions used to assess the factors in the model can be rating scale-type questions. As shown in Table 5, a single question can be used to rate each factor, resulting in a survey containing ten questions. This means that one question might be used to rate each factor. Alternatively, multiple questions can be used to rate each factor, meaning that the researcher might decide to ask as many questions as possible to rate each factor. In this case, the analysis must begin with the calculation of the average score for each of the ten questions used to assess each factor. After this, all factors need to be standardized by calculating the maximum factor score, which is always a maximum of 1. The final step is to calculate the P Score by multiplying the correlation weight of each factor with their factor score, aggregating the result, and dividing the answer by the aggregate of the correlation weight of all ten factors. The maximum possible Performance Score obtained using this formula is 1, while the minimum Score is Zero.

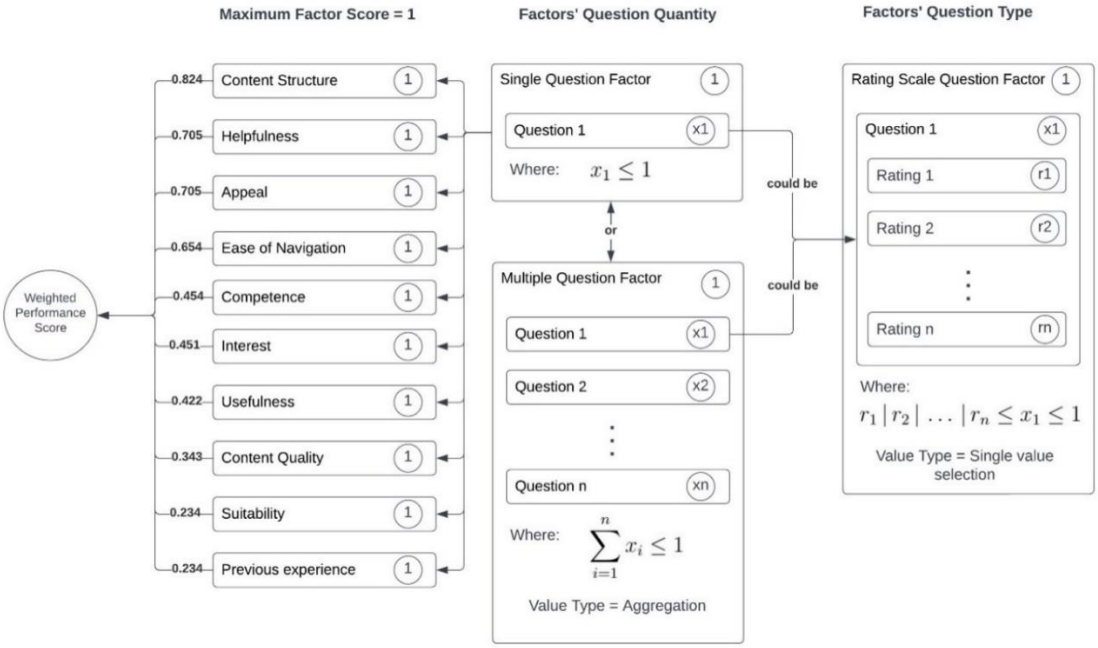

Figure 11: Operationalization of the Weighted Performance Scoring Model

Model operationalization and mapping to assessment statements

The model was operationalized using single rating and multiple rating questions to depict how it could be used for evaluating Key Performance Metrics (KPM) and as CSF for design. For each question, participants choose the rating that best represents their opinions on a scale of 1-5 (1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree). The questions were mapped to the proposed statements to assess the design, evaluation, and fitness dimensions of the weighted scoring model as was structured in the questionnaire given to experts. Table 5 presents the operationalization and mapping of the model.

Table 5: Single and multiple rating questions and mapping to proposed statements for expert judgment.

SINGLE QUESTION RATING		
Factors	**Questions**	**Mapping to Statements**
Content Structure	The content of the e-learning course was well-structured.	**Q1, Q6**
Helpfulness	The course content was sufficient to help me prepare for my exam.	**Q2, Q7**

SINGLE QUESTION RATING		
Factors	**Questions**	**Mapping to Statements**
Appeal	The layout of the screen for the online course was appealing.	**Q1**
Ease of Navigation	The platform used for e-learning was easy to navigate.	**Q1**
Competence	I feel confident in my competence in applying the knowledge I acquired from the course.	**Q8**
Interest	My interest in the subject was enhanced significantly after the course.	**Q7, Q4**
Usefulness	I found the content of the online course useful for my future medical work.	**Q9**
Content Quality	The content quality of the online course was high.	**Q6**
Suitability	The course was suitable for online teaching.	**Q3, Q5**
Previous Experience	The online course was not my first online learning experience.	**Q3**
MULTIPLE QUESTION RATING		
Factors	Questions	
Content Structure	The content of the e-learning course was well-structured.	**Q1, Q6**
	The structure of the online course made the course useful for my future medical work.	**Q2, Q8, Q9**
	The structure of the course helped me learn quickly	**Q2, Q7**
Helpfulness	The course content was sufficient to help me prepare for my exam.	**Q2, Q4, Q7**
	The course assessments were sufficient to prepare me for my exam.	**Q2, Q7**
	The course had sufficient information to help me prepare for real-world problems.	**Q9**
	The layout of the screen for the online course was appealing.	**Q1**
	An appealing screen layout inspired me to engage more with the learning resources.	**Q5, Q6**
	An appealing screen layout inspired me to engage more with my peers.	**Q5, Q6**
Ease of Navigation	The platform used for e-learning was easy to navigate.	**Q1**
	I did not encounter any difficulty while moving from one section to another.	**Q1**
	The navigation menus were intuitive.	**Q1**
Competence	I feel confident in my competence in applying the knowledge I acquired from the course.	**Q8**
	I felt competent in my ability to use the e-learning system.	**Q3, Q5**
	I feel more competent taking another e-learning course in the future.	**Q2, Q6**
Interest	I found the online course interesting.	**Q7, Q4**
	My interest in the subject was enhanced significantly after the course.	**Q4**
	I participated in most of the online discussions.	**Q5**
Usefulness	I found the content of the online course useful for my future medical work.	**Q4, Q9**
	The online course was useful in facilitating my learning experience.	**Q2, Q5**
	The online course was useful because it improved my knowledge.	**Q2, Q7**
Content Quality	The content quality of the online course was high.	**Q6**
	The content quality of the online course made my learning experience seamless.	**Q5, Q6**
	The quality of the content made me comfortable with online learning.	**Q1, Q6**

SINGLE QUESTION RATING		
Factors	**Questions**	**Mapping to Statements**
Suitability	The course was suitable for online teaching.	**Q3, Q5**
	The content of the course was easy for me to understand because it was taught online.	**Q3, Q5, Q7**
	The assessments of the course were well-suited for online learning.	**Q3, Q5**
Previous Experience	The online course was not my first online learning experience.	**Q3**
	My previous experience in online learning helped me perform better in the course.	**Q3, Q8**
	I acquired digital skills from the online course that I could use for future courses.	**Q4**

Given the clarity provided on the model to experts, the same questionnaire was used for the second round because there were no complaints concerning the clarity of the questionnaire but rather the clarity of the model.

Descriptive analysis

The second round of the Delphi method was conducted on the 28th of September, 2023, and concluded on the 30th of October, 2023. Fourteen invitations were sent via email, and all 14 responses were received. Table 6 summarizes the collective results of the phase, including average assessments, medians, standard deviations, and the percentage of agreement and disagreement among the 14 experts for each statement.

Table 6: Collective results for the second round

Dimension	Statement	Average	Median	Standard deviation	% Agreement	% Disagreement	No opinion
Design	Q1	4.50	4.50	0.50	100	0.0	0.0
	Q2	4.43	4.00	0.49	100	0.0	0.0
	Q3	4.43	4.00	0.49	100	0.0	0.0
	Q4	4.57	5.00	0.49	100	0.0	0.0
	Q5	4.50	4.50	0.50	100	0.0	0.0
Evaluation	Q6	4.71	5.00	0.45	100	0.0	0.0
	Q7	4.64	5.00	0.48	100	0.0	0.0
	Q8	4.57	5.00	0.49	100	0.0	0.0
	Q9	4.57	5.00	0.49	100	0.0	0.0
Fitness	Q10	4.36	4.00	0.48	100	0.0	0.0
	Q11	4.43	4.00	0.49	100	0.0	0.0

Table 6 shows an increase in mean, median, and standard deviation, implying that experts agree with the proposed statements in all dimensions, with the average of all statements being 4.52 and the median of all statements being 4.50. This means that experts are convinced that the model is fit for efficiently designing and evaluating e-learning courses in medical education. This might be due to the detailed information provided to experts via email concerning the model's need, purpose, journey, and outputs to give more clarity. Explaining and operationalizing the model using two questionnaires and consequent mapping to the statements of the instrument used in round one of the Delphi method proved effective. The box and whisker graph (figure 12) shows the aggregate of experts' agreement for all statements in the second round.

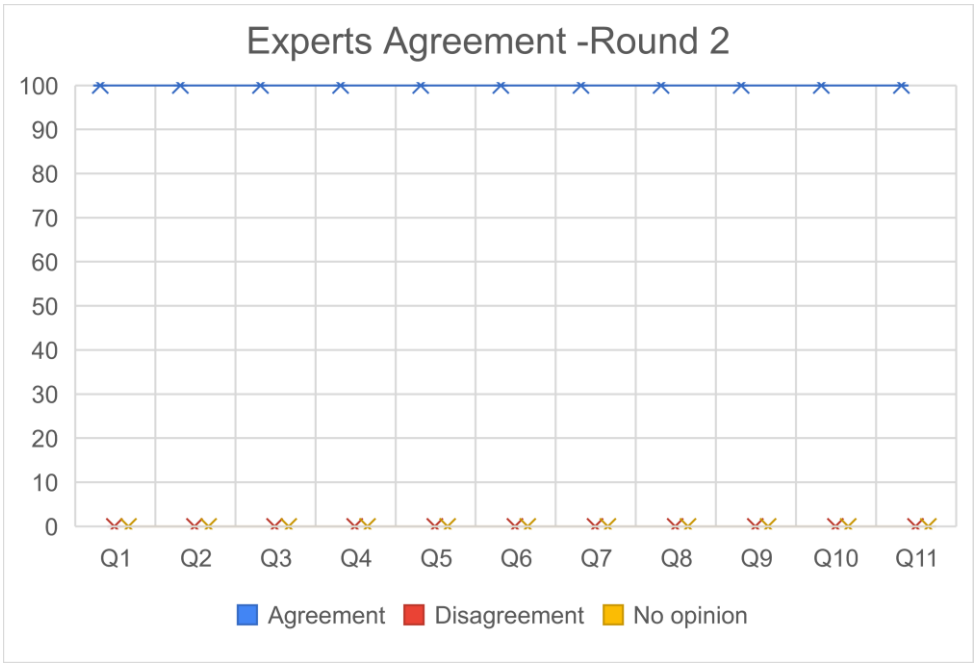

Figure 12: Aggregated experts' agreement for all statements using the box and whiskers graph from the first round

Delphi Conclusion

The panel reached a high level of agreement on all the proposed statements in the second round (figure 13). Strong agreements are confirmed when specific criteria are met, including an average assessment of 3.7 or higher, a median of 4, and at least 60% agreement from a minimum of 12 experts. Slight agreement is confirmed with an average assessment between 3.5 and 3.7, a median equal to or higher than 3.5, and at least 45% agreement from a minimum of 12 experts.

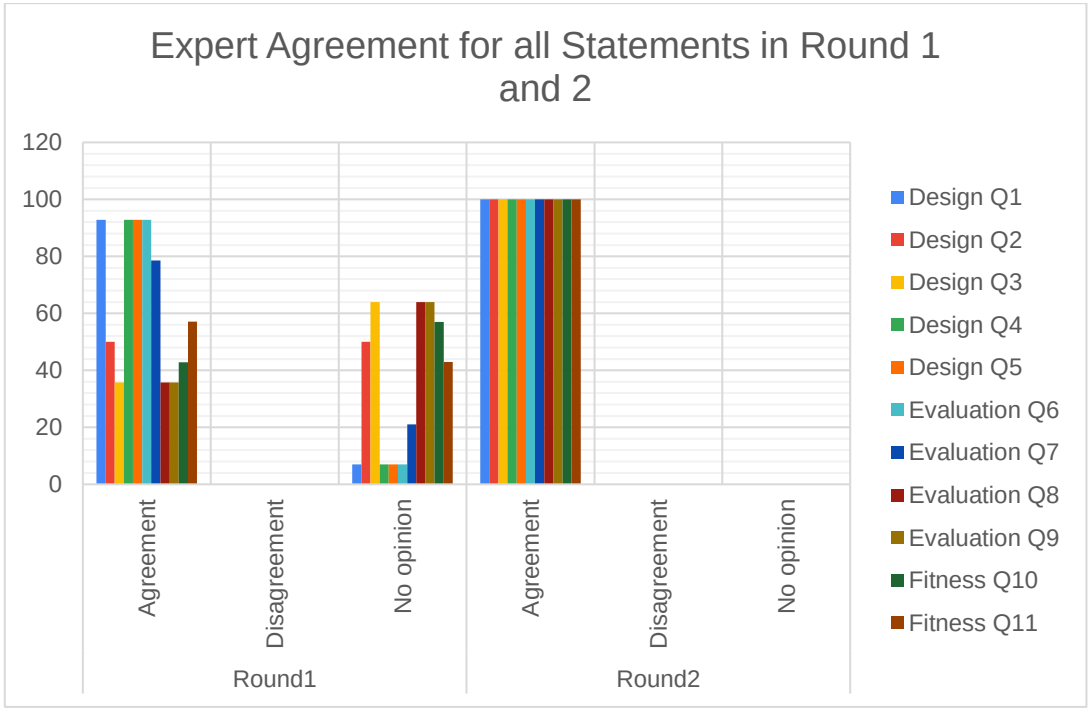

Figure 13: Expert agreement for all statements in rounds 1 and 2.

All 11 statements had an average of 52% strong agreement and 48% agreement from all 14 experts, with the evaluation dimension having the strongest agreement, next to the design dimension. The validity of the fitness

dimensions relies on the results of the first two dimensions. Although all experts agreed that the model presents a coherent and efficient approach to designing and evaluating e-learning courses in medical education, an expert suggested that the results of analysis using the model be correlated to the actual average class performance score in the e-learning course. This is a research area to be considered in the future. Also, another expert proposed that the model be expanded for performance prediction modeling and that the prediction graph be correlated to the performance graph when evaluating e-learning courses in medical education. This is also perceived as a call for future research.

4. Conclusion

E-learning is a comprehensive concept encompassing the asynchronous or synchronous dissemination of knowledge to learners via electronic systems. Recently, e-learning has garnered significant recognition as a mainstream approach in health sciences education (HSE), encompassing medical, dental, public health, nursing, and other allied healthcare disciplines. However, considerable debate remains surrounding the role of e-learning, its impact on learners' performance and learning enhancement. In this study, a comprehensive content validation of a model designed to assess the performance of e-learning in medical education through expert judgment was conducted using the Delphi method. The model underwent rigorous scrutiny from 14 experts. Our analysis reveals that the model demonstrates a high level of agreement among experts, meeting the predefined criteria for both strong and slight agreement. The dimensions related to evaluation and design garnered the strongest agreements, emphasizing the model's coherence and efficacy in designing and evaluating e-learning courses in medical education. The Delphi method proved a suitable and effective expert judgment technique for this study, allowing for anonymity, iteration, controlled feedback, and statistical group response. The analysis incorporated descriptive statistics, Cronbach's alpha reliability prediction, and Simple Correspondence Analysis (SCA) to assess consensus, reliability, homogeneity, and stability among experts. The panel's high level of agreement on the proposed statements after the second round affirms the robustness of the model.

- This study significantly contributes to e-learning in medical education by conducting a content validation of a performance assessment model. It provides a comprehensive overview of expert validation methods, shares practical outcomes, and offers preliminary insights into the model's validity, paving the way for future research directions. The contribution provided by this study includes the following:
- The study provides a thorough overview of the factors essential for crafting an expert validation method tailored explicitly for assessing the performance of a weighted performance scoring model in e-learning.
- It shares practical outcomes of applying the expert judgment method to a weighted performance scoring model in a real-world scenario within the context of medical education. This practical insight adds value by demonstrating the model's applicability and effectiveness in an educational setting.
- It advances our understanding of the validity of the weighted performance scoring model by presenting preliminary findings across its various dimensions. This empirical evidence adds depth to the current knowledge regarding the model's effectiveness and potential areas for refinement.
- It concludes with significant insights from the research findings and proposes future avenues for continued exploration and enhancement of performance evaluation models in e-learning within the medical education domain. This contributes to ongoing discussions and guides future research endeavors in this field.

5. Limitations and Future Work

While our study provides valuable insights into the content validity of the proposed model, certain limitations should be acknowledged. The Delphi method, while effective, relies on expert opinions, and variations in expertise or perspectives may impact the results. Additionally, the study focused on the dimensions of design and evaluation; future research should consider expanding the model to address performance prediction and correlation with actual class performance scores, as suggested by the experts. Future research endeavors should explore the correlation between the results obtained through the model and actual class performance scores in e-learning courses in medical education. Additionally, there is a call for extending the model to encompass performance prediction modeling, with a focus on correlating prediction graphs with performance graphs during the evaluation of e-learning courses. These suggestions pave the way for further refinement and application of the model, contributing to the ongoing discourse on enhancing the effectiveness of e-learning in the medical education domain.

Statement of Open Data, ethics, and conflict of interest

Requests for the data can be addressed to the corresponding author. The approval for conducting this research was received from the University of KwaZulu-Natal, South Africa. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Examining Student Characteristics, Self-Regulated Learning Strategies, and Their Perceived Effects on Satisfaction and Academic Performance in MOOCs

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Abstract: The ultimate goals of education and training are the development of learners' learning outcomes. The prospect of achieving high academic results should function as a driving force for students to be engaged in learning. Recognition of the factors affecting their learning satisfaction should facilitate their learning process, especially in online learning environments such as Massive Open Online Courses (MOOCs). The purpose of this study was to examine the interactions among students' characteristics, their perceived values of self-regulated learning (SRL) strategies, satisfaction and academic performances. A mixed-methods design was employed to investigate the issue under exploration. The 227 surveyed responses were collected from English majors who had experience in MOOCs and were studying at a private university in Can Tho city in the Mekong Delta, Vietnam. Data from the survey was analysed with the Statistical Package for the Social Sciences (SPSS) 25 for the correlations between their characteristics and the quantitative variables, while Partial Least Squares Structural Equation Modelling (PLS-SEM) was performed to examine the perceived effects of self-regulated learning (SRL) strategies on their satisfaction and academic outcomes. Qualitative data was collected through open-ended survey questions and analysed based on thematic analysis guidelines. The results revealed that SRL strategies such as strategic planning, time management, environment structuring, and help-seeking positively influenced both student satisfaction and academic performance. Notably, the study identified flexible learning time, self-paced learning, and the ability to choose study locations as significant factors enhancing student satisfaction. Conversely, limited social interaction, poor internet connectivity, and low motivation were found to be demotivating factors. Additionally, the study highlighted the importance of gender and prior online learning experience in shaping students' satisfaction and performance in MOOCs. While gender showed no significant correlation with SRL strategies, satisfaction, or academic performance, prior experience in online learning environments, such as the number of completed MOOC courses, was significantly correlated with better academic outcomes. However, a weak negative correlation between students' academic years and their satisfaction was observed, suggesting that more advanced students might face increased academic pressure and higher expectations, leading to lower satisfaction levels. The research underscores the critical role of SRL strategies in facilitating effective learning in MOOCs, especially in the context of English major students who often lack direct interaction with instructors and peers. Training students in SRL strategies can help them better manage their learning processes, overcome challenges, and achieve their academic goals. This study contributes to the understanding of how student characteristics and SRL strategies affect learning in online environments and suggests practical implications for enhancing MOOC experiences. Future research should investigate additional SRL strategies and include a larger, more diverse sample to provide a more comprehensive understanding of their impact on student satisfaction and academic performance in MOOCs. Furthermore, exploring the specific challenges faced by different academic disciplines in MOOCs could offer more tailored solutions to improve online learning experiences.

Keywords: Self-regulated learning, MOOCs, Online learning, Satisfaction, Academic achievements

1. Introduction

Learning in MOOCs has become ubiquitous since 2012 (Waks, 2019). This kind of learning requires learners to complete all the tasks by watching video lessons, completing quizzes, doing assignments and giving feedback to their course-mates by a certain deadline. A MOOC's duration can range from 1 to 16 weeks depending on the course content, difficulty, and learners' expected time commitment (Bowden, 2021). Teacher-student(s) interaction is almost not a feature of this learning mode. The presence of peers during their learning is very limited. This learning mode is referred to as self-regulated learning (SRL). This is considered a skill that can be honed (Schunk, 2005; Zimmerman, 2015), especially in a virtual learning environment (Amiruddin, et al., 2023).

One of the ways to help learners to become self-regulated is to train them to use SRL strategies. These strategies have been proven to be beneficial to academic results (Broadbent and Poon, 2015; Santos and Alliprandini, 2023), and have helped students to direct their self-regulation during the online learning process (Arjaya, et al.,

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2023). However, students' perceptions of the usefulness of these strategies would affect their use of them in their learning (Versteeg, et al., 2021).

Despite the acknowledged significance of self-regulated learning (SRL) strategies, there is a limited understanding of how these strategies interact with students' characteristics, such as gender, academic year, and prior MOOCs experience, and how they affect students' satisfaction and academic performance in MOOCs. This gap in knowledge hinders the development of targeted interventions that could enhance students' online learning experiences and outcomes.

The present study aims to a) examine the correlation among students' characteristics (gender, school year, background, and MOOCs experiences), online satisfaction, and academic achievements, and b) investigate the perceived effects of SRL strategies on students' satisfaction and academic results. To find the answer to these aims, we proposed two research questions:

- RQ1: Do differences in students' characteristics (gender, school year, background, and MOOCs experiences) correlate with their self-regulated learning strategies, student satisfaction, and academic achievement?
- RQ2: Do students' perceived values of self-regulated learning strategies affect their satisfaction and academic achievement in learning in MOOCs?

To achieve these objectives, this paper is structured as follows:

The Literature Review section discusses existing research on learning in MOOCs, student characteristics in online learning, and the impact of SRL strategies on satisfaction and academic performance.

The Methodology section outlines the mixed-methods design employed in the study, describes the data collection methods and how they were analysed.

The Findings section presents the results of the quantitative and qualitative analyses, highlighting key correlations and perceived effects.

The Discussion section interprets the findings in the context of existing literature, offering insights into theoretical and practical implications for MOOCs and online learning environments.

The Conclusion and Limitations section summarizes the study's major findings and contributions, acknowledges its limitations, and suggests directions for future research.

2. Literature Review

2.1 Discrepancy of Learning Styles in High School and University

Secondary and high school education requires teachers to teach their students set curriculum subjects to meet certain levels of completion of compulsory education standards. The students' academic achievements are reflected in their grades. Therefore, students' learning results seem to be put on the teachers' shoulders, and so the teachers' roles are quite dominant in the teaching and learning process.

Consequently, higher demands on self-regulated learning at tertiary levels, challenged students who had just transferred from high school to university (Vosniadou, 2020). This raised a need for further exploration of SRL values among first year students.

2.2 Learning in MOOCs

In MOOCs, study courses were pre-designed with prepared video lessons with transcriptions alongside (Mor and Warburton, 2016). Learners, regardless of age or educational background, can gain access to these courses for free, with the exception of earning certificate needs (Glass, Shiokawa-Baklan and Saltarelli, 2016).

MOOCs learners are required to complete their registered courses within 3 months (Chavez, 2020). During the study, they are required to watch the recorded video lessons, then complete some quizzes related to the lessons (Comer and White, 2016). They can also post a query in the discussion forum to ask for help (Ortoleva and Bétrancourt, 2016). After each week, normally, they have to do an assignment which requires them to apply the knowledge gained from the lessons, and do peer-grading for their course-mates' work as well (Comer and White, 2016). When all these things are done, the course administrators would issue them a certificate for the recognition of their course accomplishment.

It can be seen that learning in MOOCs requires students mainly to self-regulate their learning as well as socialize with course-mates to study.

2.3 Student Characteristics and Online Learning

Pintrich (2000) postulated that SRL processes can help mediate students' characteristics and external contexts to enhance their academic outcomes. Moreover, understanding the goodness of fit or match between the learner's characteristics and the characteristics of their learning contexts is important for academic emotions and motivation (Webster and Hadwin, 2015).

Previous studies indicated contradictory findings of the roles of gender in students' academic outcomes as well as their satisfaction in online learning. The study by Yu (2021) found that there were no statistically significant differences in the level of satisfaction based on gender, age, or level of study. A similar study also showed no difference in learning satisfaction among males and females in online learning (Harvey, Parahoo and Santally, 2017). Nevertheless, a recent study by Dinh, et al. (2022) found a correlation between gender and satisfaction when university students studied in asynchronous and synchronous online environments from various universities in the Mekong Delta in Vietnam, but no correlation with SRL strategies. However, Virtanen and Nevgi (2010) confirmed the interrelations of gender and SRL components. This finding was supported by other studies in the field of SRL writing for English as a Foreign Language (EFL) students (Bai, Shen and Mei, 2020) and online SRL for high school students (Liu, et al., 2021).

Given the correlation between gender and learning outcomes, female students who study at fixed times and locations tend to have higher overall grades when studying online (Du, et al., 2019), whereas another study reviewed no significant difference in academic achievement regarding students' gender (Adigun, et al., 2015). Similarly, Lim, et al. (2009) indicated that course outcomes, instructional, and learner variables were not significantly different between male and female learners. Given these contradictory findings, we proposed null and alternative hypotheses as follows:

Hypothesis 1. *The gender of learners is not correlated with online learning satisfaction.*

Hypothesis 2. *The gender of learners is significantly correlated with online academic performances.*

Hypothesis 3. *The gender of learners is significantly correlated with online SRL strategies.*

Prior experiences in online learning have been well documented in online achievements (Cho and Kim, 2013; Jan, 2015). However, the role of this factor has been shown inconclusive in an online environment. Yukselturk and Bulut (2009) reported that gender, educational level, and the previous number of online courses taken do not statistically significantly predict the current online course satisfaction or students' achievement. In addition, Cho and Kim (2013) found that previous online experience was not related to the ability of students to self-regulate for interaction with others. Nonetheless, Wang, Shannon and Ross (2013) signposted that previous online learning experience directly influences self-regulated learning. Holcomb, King, and Brown (2004) found that previous experience with online learning has a significant impact on students' self-regulation skills. From the above literature review, the following hypotheses were proposed:

Hypothesis 4. *Learners' prior experience (academic school years, numbers of finished MOOC courses) in MOOCs is significantly correlated with online learning satisfaction.*

Hypothesis 5. *Learners' prior experience (academic school years, numbers of finished MOOC courses) in MOOCs is significantly correlated with online academic performances.*

Hypothesis 6. *Learners' prior experience (academic school years, numbers of finished MOOC courses) in MOOCs is significantly correlated with self-regulated learning skills.*

2.4 Self-Regulated Learning Strategies in MOOCs

Self-regulated learning (SRL) is a fundamental skill for succeeding in MOOCs, but many learners do not know how to self-regulate their learning or face various obstacles in the MOOC environment (Vilkova, 2022). In MOOCs, previous research has found seven SRL strategies that work for students, including setting goals, time management, self-evaluation, strategic planning, task strategies, elaboration, and help seeking (Littlejohn, et al., 2016; Kizilcec, Pérez-Sanagustín and Maldonado, 2017). In addition, Jansen, et al. (2017), from their developed tool based on previous studies, found that the other two strategies, persistence and environmental structuring in particular, also contributed to effectively measure students' SRL strategies in MOOCs.

SRL strategies include components which are categorized into four domains, namely cognitive engagement, metacognitive knowledge, resource management (Zimmerman and Martinez-Pons, 1986), and motivational beliefs (Pintrich, 1999).

Recently, Wan, Compeau and Haggerty (2012) proposed two types of SRL strategies, namely, personal and social SRL strategies. They argued that personal SRL strategies were intrapersonal strategies where learners utilized their cognitive, metacognitive, and motivational efforts to consciously manage their own learning processes, while social SRL strategies involved social interactions with others such as peers, instructors, managers, and IT professionals to navigate learners' SRL strategies during their learning.

2.5 Effects of Online SRL Strategies on Satisfaction

Student satisfaction is considered one of the important subjective measurements to measure students' non-academic outcomes, and can be calculated by self-report questionnaires (Bowyer and Chambers, 2017). Identifying student satisfaction is essential since it helps educators to assist students with their learning progression (Anthonysamy, Koo and Hew, 2020).

An empirical study by Ejubović and Puška (2019) showed that metacognitive strategies had a significantly positive impact on student satisfaction in an online environment, while the goal-setting variable ran counter to student satisfaction. This result echoed a study by Puzziferro (2008) asserting that metacognitive self-regulation was positively correlated with levels of satisfaction. However, metacognitive self-regulation was found not correlated with students in a study by Kuo, et al. (2013). The possible explanation for this may originate from the time constraint. Students with more time online were more self-regulated, resulting in better knowledge comprehension.

Not many studies have revealed the impact of cognitive strategies on student satisfaction. Cho and Heron (2015) revealed that cognitive strategies did not predict student achievement and satisfaction while rehearsal, elaboration, and time and study environment showed a significantly positive correlation with levels of satisfaction (Puzziferro, 2008). Dinh, et al. (2022) identified significant correlations of SRL strategies with students' satisfaction and academic achievements in higher education contexts in Vietnam. However, the study did not show how SRL strategies impacted these two essential factors and what types of online learning.

Although empirical studies of SRL strategies on student satisfaction are small in number to date, the role of student satisfaction in the teaching and learning process cannot be overlooked since student satisfaction is one of measurement to evaluate the effectiveness of blended learning adoption in general (Wu, Tennyson and Hsia, 2010).

2.6 Other Factors Affecting Students' Satisfaction and Dissatisfactions in MOOCs

Previous students have revealed several other key factors affecting students' satisfaction with MOOCs. First, the flexibility, such as self-paced learning and flexible timing, allows students to fit their studies into their schedules, greatly enhancing their satisfaction (Watted and Barak, 2018). The quality of course content and interactive components also determine if students will continue to engage in the course and their learning satisfaction in MOOCs (Margaryan, Bianco and Littlejohn, 2015; Wang, et al., 2022; Díez-Arcón, 2023). Similarly, support systems in the form of availing opportunities for peer interaction and instructor's timely feedback are pivotal to a supportive learning environment for students, which enhances their engagement and satisfaction (Strom, Margolis and Polat, 2019; Wang, et al., 2022).

However, limited interactions with instructors and peers also lead to feelings of isolation, disengagement, and dissatisfaction (Zhang, Chen and Phang, 2018; Garg and Goel, 2021; Wang, 2021). Additionally, rigid deadlines that do not accommodate students' varying schedules also contribute to stress and dissatisfaction (Ihantola, et al., 2020). Moreover, low motivation and a lack of engaging content can hinder students' ability to stay focused and committed, leading to higher dropout rates and dissatisfaction (Azhar, et al., 2023; Cilliers, Twinomurinzi and Murire, 2023). Therefore, rectification of these factors is important for enhancing the overall experience of MOOCs and ensuring a higher degree of satisfaction from the students.

2.7 Effects of Online SRL Strategies on Academic Achievements

In the study by Kizilcec, et al. (2017), a large population number of 4,831 participants were surveyed by an adapted OSLQ instrument by Barnard, Paton, and Lan (2008), and Littlejohn and Milligan (2015). The results indicated that the more learners become involved in goal setting and strategy planning, the more they attain their course goals.

In 2020, Kizilcec and his team conducted a study on the effects of plan-making interventions and "value-relevance" interventions on course completion. The results showed that there was no significance in both interventions and that SRL interventions had short-lived effects and that continuous support is needed. They also suggested integrating context-specific information into the SRL interventions so as to induce variation in the effects of the interventions (Kizilcec, et al., 2020).

An investigation into the relationship between self-regulated learning skills and achievement was researched by Turan and Demirel (2010). The findings indicated that learners' self-regulated learning skills are beneficial for students' understanding of a subject area and the improvement of their learning self-efficacy. What is more, the results of a recent study by Tadesse, et al. (2022) showed that SRL strategies significantly predicted students' perceived learning, with the help-seeking component being the most influential. In particular, the use of SRLSs by undergraduate students was found to be moderate, indicating average performance.

However, there was no significant relationship between the use of SRL strategies and English achievement (Mahmoodi, Kalantari and Ghaslani, 2014). In the same vein, Kim, Park and Cozart (2014) found no significant correlation between cognitive strategy and metacognitive self-regulation and student achievement in an online mathematics course.

In light of the previous studies presented in the literature review section, we proposed the following hypotheses of the effects of SRL strategies on satisfaction and academic achievements:

Hypothesis 7: *Environmental structuring directly affects students' satisfaction (SS) in MOOCs*

Hypothesis 8: *Environmental structuring directly affects students' academic achievements (AA) in MOOCs*

Hypothesis 9: *Help-seeking directly affects students' satisfaction (SS) in MOOCs*

Hypothesis 10: *Help-seeking directly affects students' academic achievements (AA) in MOOCs*

Hypothesis 11: *Strategic planning directly affects students' satisfaction (SS) in MOOCs*

Hypothesis 12: *Strategic planning directly affects students' academic achievements (AA) in MOOCs*

Hypothesis 13: *Time management directly affects students' satisfaction (SS) in MOOCs*

Hypothesis 14: *Time management directly affects students' academic achievements (AA) in MOOCs*

Hypothesis 15: *Students' satisfaction directly affects their academic achievements (AA) in MOOCs*

The proposed research model and hypotheses are illustrated in Figure 1 below.

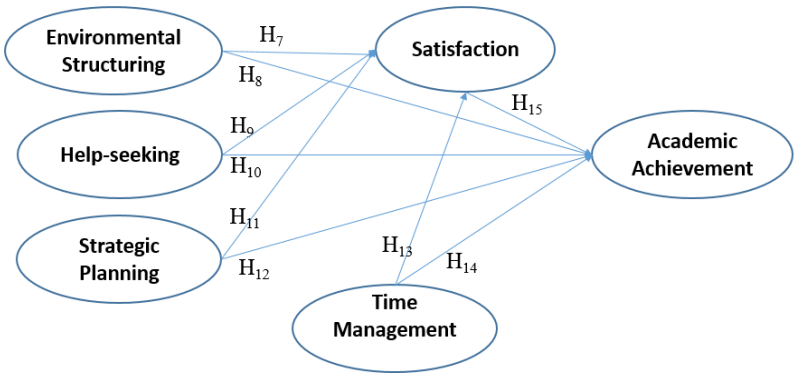

Figure 1: The hypotheses of the effects of SRL strategies on satisfaction and academic achievements

3. Method

3.1 Research Design

This study utilized a convergent mixed methods design, in which quantitative and qualitative data were collected at the same time. The data analysis was performed separately, and then combined in order to provide a more compressive view on the research problem (Creswell and Creswell, 2018).

In this study, a questionnaire survey with 24 five-point Likert scale items used to measure the perceived effects of SRL strategies on students' satisfaction and academic achievement, ranging from "1-Strongly Disagree" to "5-Strongly Agree", and two open-ended questions to investigate how other factors affect their satisfaction or dissatisfaction in MOOCs learning, for example, "What factors are you not satisfied with in online courses?", and "What factors are you satisfied with in online courses?"

3.2 Participants

Two hundred and twenty-seven participants of the current study were English major students who were required to study one specialization (including at least three courses) in MOOCs, via Coursera platforms, per semester, roughly three months long, at a private university in Can Tho city in the Mekong Delta, Vietnam. They are first year, second year, and third year English major students, aging from 18-20. Data collection was performed from October 10th to December 14th, 2023. A link to the Questionnaires and a Consent Form were sent to these participants.

For an acceptable data analysis in the PLS-SEM model, according to Kock and Hadaya (2018), to obtain a significant level of 5% with a minimum path coefficient (pmin) of 0.2, the minimum sample size (nmin) is estimated by the following equation: nmin>((2.846/pmin)^2) → nmin>((2/846/0.2)^2) = 154.505, so the minimum sample size is 155. Among 238 received responses, 227 were qualified for further data analysis. Table 1 below provides a detailed description of the participants.

Table 1: Participant demographics

Categories	Characteristics	N	Percentage (%)
Gender	Male	72	65.64
	Female	149	31.72
	Rather not to say	6	2.64
Age	18-22	227	100
Academic School Year	1st year	16	7.05
	2nd year	131	57.71
	3rd year	46	20.26
	4th year	34	14.98
Number of MOOCs Courses	Fewer than 3	50	34.36
	3-5	78	22.03
	More than 5	99	43.61

3.3 Research Instruments

The study instrument included two sections in which quantitative survey items were adapted from previous studies. In particular, Part 1 of the questionnaire comprised self-devised items featuring the participants' demographic information, such as gender, age, academic school year, and factors causing them to feel satisfied or dissatisfied with their learning in MOOCs; Part 2 included SRL strategy items which were documented in the literature, and were presumed to have an impact on students' satisfaction and academic achievements in the MOOCs environment. The items related to students' satisfaction, and academic achievement were adapted from Ejubović and Puška (2019); those related to students' environment structuring, help-seeking, and time management were adapted from Barnard-Brak, Paton and Lan (2010), and a strategic planning item from Kizilcec, Pérez-Sanagustín and Maldonado (2017). This section consisted of 24 modified items, using the 5-point Likert scale, coded from 1 "Strongly Disagree" to 5 "Strongly Agree". The questionnaire survey was translated into Vietnamese, and was bilingual, i.e. English-Vietnamese. To ensure the accuracy and credibility of the data, the two authors cross-checked the translation. In addition, the study also employed qualitative data from open-ended questions, which students could answer in Vietnamese or English at their convenience. In this study, students entered only English, so the authors used their English version without any further translation. The qualitative data was coded independently by the two researchers in order to figure out other factors affecting student satisfaction and dissatisfaction in MOOCs. The inter-rater agreement percentage between the two coders should be above 75% (Mackey and Gass, 2022). Any cases of disagreement were resolved through further discussion. If no agreement was reached on certain themes, they were excluded from the analysis. In our case, the agreement was 85%.

3.4 Data Collection Procedures

3.4.1 Piloting phase

Prior to official data collection for analysis, a pilot test was conducted with sixty-five students who have studied online courses at the same university as the participants of the current study. This phase is essential to ensure the internal reliability of the items of the instrument and to help evaluate the respondent's comprehension as well. The content of the email, in Vietnamese, included information about the research purpose, the specific time of the data collection, and their consent to voluntarily participate in the research. After completion of the questionnaire, the data was automatically saved in the Google Sheets application which could only be accessed by the research team.

The Cronbach's Alpha of variables used in the piloting phase were all above 0.7 (Item 5 of Variable Help-seeking_HS5 was deleted since its corrected item-total correlation = -0.097 < 0.3 (Hajjar, 2018), indicating that the instrument was reliable (Table 2).

Table 2: Construct reliability of the piloting phase

Variables	Cronbach's Alpha	N of Items
Environment Structuring (ES)	.825	4
Time Management (TM)	.912	3
Strategic Planning (SP)	.836	4
Help Seeking (HS)	.707	4
Satisfaction (SS)	.904	4
Academic Achievement (AA)	.858	4

3.4.2 The actual research data collection procedures

Questionnaires were administered to the participants via their emails which were obtained from the university open access website for its personnel. Data were collected from March 9th - 26th, 2023. In order to obtain students' voluntary participation, an email of research introduction and information related to the study, a link to the questionnaire and a Consent Form were sent to them. The items in Section 2 were bilingual (i.e., in English and Vietnamese) to facilitate the participants' understanding of the items. After the data collection completion, the data was automatically saved in the Google Sheets application which could only be accessed by the researcher.

After the screening and filtering process for duplication and items needing revision, 227 out of the 238 responses obtained qualified for data analysis. The internal consistency of all variables was re-tested.

Table 3 below indicates the reliability of the questionnaire in the actual data collection phase.

Table 3: Reliability of the instrument in the actual phase

Variables	Cronbach's Alpha	N of Items
Environment Structuring	.854	4
Time Management	.858	3
Strategic Planning	.818	4
Help Seeking	.724	4
Satisfaction	.905	4
Academic Achievement	.860	4

3.5 Data Analysis

To examine the correlation between the qualitative and quantitative variables and the impact of the endogenous variables on the exogenous ones, SPSS 25 and PLS-SEM 4 were utilized. The use of the partial least squares-based structural equation modelling (PLS-SEM) has proved to be helpful in explaining causal-predictive relationships between dependent and independent variables (Hair Jr, et al., 2021).

For qualitative data analysis, we employed thematic analysis (Braun and Clarke, 2006) to identify codes, and then generate themes based on these codes in relation to factors affecting their satisfaction and dissatisfaction when learning in MOOCs.

4. Findings

4.1 Quantitative Results

4.1.1 The reliability and validity of the instrument

In order to test the research constructs' reliability and convergent validity, Composite Reliability (CR), Cronbach's Alpha, Average Variance Extracted (AVE), and the factor loadings of each indicator were performed as indicated in Table 4 below:

Table 4: Measurement model parameter estimation

Dimensions	Items	Factor loading	Cronbach's Alpha	CR	AVE
Time management (TM)	TM1	0.735	0.845	0.844	0.644
	TM2	0.813			
	TM3	0.855			
Environmental structuring (ES)	ES3	0.734	0.719	0.719	0.526
	ES4	0.765			
Help seeking (HS)	HS1	0.766	0.807	0.806	0.581
	HS2	0.805			
	HS3	0.713			
Strategic planning (SP)	SP2	0.742	0.772	0.775	0.634
	SP3	0.847			
Satisfaction (SS)	SS1	0.783	0.898	0.899	0.689
	SS2	0.824			
	SS3	0.855			
	SS4	0.857			
Academic achievement (AA)	AA3	0.884	0.795	0.801	0.670
	AA4	0.747			

Table 4 indicated the proposed model constructs obtained reliability and convergent validity: the indicator reliability (factor loading > 0.7), internal consistency reliability (Cronbach's Alpha > 0.7, and CR > 0.7) and the convergent validity (AVE > 0.5) (Hair Jr, et al., 2021). Other items, namely ES1, ES2, HS4, SP1, SP4, AA1, and AA2, were removed since they incurred collinearity with other variables.

What is more, in order to test the constructs' discriminant validity, Heterotrait–Monotrait Raito (HTMT) was performed (Table 5). All values are below 0.85, thus the discriminant validity of the constructs is affirmed (Henseler, Ringle and Sarstedt, 2015).

Table 5 below shows that the research constructs are distinct from each other.

Table 5: Discriminant validity

Dimension	AA	ES	HS	SP	SS
Academic achievement (AA)					
Environmental structuring (ES)	0.136				
Help seeking (HS)	0.324	0.518			
Strategic planning	0.326	0.677	0.475		
Satisfaction (SS)	0.819	0.351	0.422	0.594	

Dimension	AA	ES	HS	SP	SS
Time management (TM)	0.395	0.538	0.591	0.531	0.493

4.1.2 Collinearity analysis

The variance inflation factor (VIF) should be below 3 to avoid extreme multi-collinearity (Hair Jr *et al.*, 2019). Table 6 below indicated that all constructs' VIFs are smaller than 3. Hence, the collinearity was not a problem of the structural model.

Table 6: Evaluating the collinearity of the structural model

Dimension	AA	SS
Academic achievement (AA)		
Environmental structuring (ES)	2.154	2.075
Help seeking (HS)	1.723	1.693
Strategic planning	2.499	1.99
Satisfaction (SS)	1.724	
Time management (TM)	1.918	1.818

4.1.3 Structural Equation Modelling Analysis

According to Hair Jr et al. (Hair Jr *et al.*, 2019), the coefficient of determination R-square (R2), which should vary from 0.25 - 0.9), and the path coefficients which is tested by bootstrapping technique should be considered for the structural model evaluation.

As can be shown in Table 7, the adjusted R2 values of Satisfaction and Academic Achievement are equal to 0.409 and 0.713, respectively indicating moderate and substantial explanatory relationships among dependent and independent variables of the study.

Table 7: R2 Values

Dimension	R2	R2 Adjusted
Satisfaction (SS)	0.42	0.409
Academic achievement (AA)	0.719	0.713

4.1.4 Hypotheses testing

Tables 8 below shows the path coefficients and p-values of each hypothesis. All hypotheses were supported since p-value <0.05.

Table 8: Hypotheses Testing Results

Hypothesis	Paths	Path Coefficients	p-value	Results
H6	ES -> SS	-0.214	< .001	Supported
H7	ES -> AA	-0.13	< .001	Supported
H8	HS -> SS	0.131	< .001	Supported
H9	HS -> AA	0.047	< .001	Supported
H10	SP -> SS	0.543	< .001	Supported
H11	SP -> AA	-0.193	< .001	Supported
H12	SS -> AA	0.916	< .001	Supported
H13	TM -> AA	0.086	< .001	Supported
H14	TM -> SS	0.242	< .001	Supported

The statistics presented in Table 8 reveal a negative relationship between ES and both SS and AA, estimated at -0.214 and -0.13, respectively. This indicates that an over-emphasized structuration of the learning environment might detract from actual learning and enjoyment because of increased cognitive load or stress. In a similar manner, strategic planning (SP) has a negative impact on academic achievement, as represented by the path

coefficient of -0.193, which points out that overemphasizing planning without sufficient execution can negatively affect academic performance.

On the other hand, help-seeking positively relates to student satisfaction and academic achievement: 0.131 and 0.047, respectively, although correlation to academic achievement is relatively small. Strategic planning (SP) is greatly related to the satisfaction of students: 0.543, pointing out that effective planning plays a critical role in creating a satisfying experience of learning. Student satisfaction was found to be a powerful predictor of academic achievement: 0.916. This strongly suggests that it increases academic performance quite a lot.

Time management had positive relations with both student satisfaction and academic achievement: 0.242 and 0.086, respectively, and a more significant association with satisfaction. This suggests that effective time management is crucial for both enjoying the learning process and achieving good academic results.

Table 9 below indicated the effect size (f-square) of the independent constructs on the dependent ones, namely Satisfaction and Academic Achievement. The results from Table 9 reveal that the effect size of Satisfaction (SS) on Academic Achievement (AA), and of Structuring Planning on Academic Achievement were substantial, while the effects of Environmental Structuring (ES) on AA, ES on SS, SP on AA, and Time management (TM) on SS were small.

Table 9: The effect size of the independent constructs on the dependent ones

	f-square		f-square
ES -> AA	0.028	SP -> SS	0.256
ES -> SS	0.038	SS -> AA	1.732
HS -> AA	0.005	TM -> AA	0.014
HS -> SS	0.017	TM -> SS	0.055
SP -> AA	0.053		

In order to visualize the results of hypotheses testing and the coefficient of determination R-square (R2) of the model, Figure 2 is showcased below:

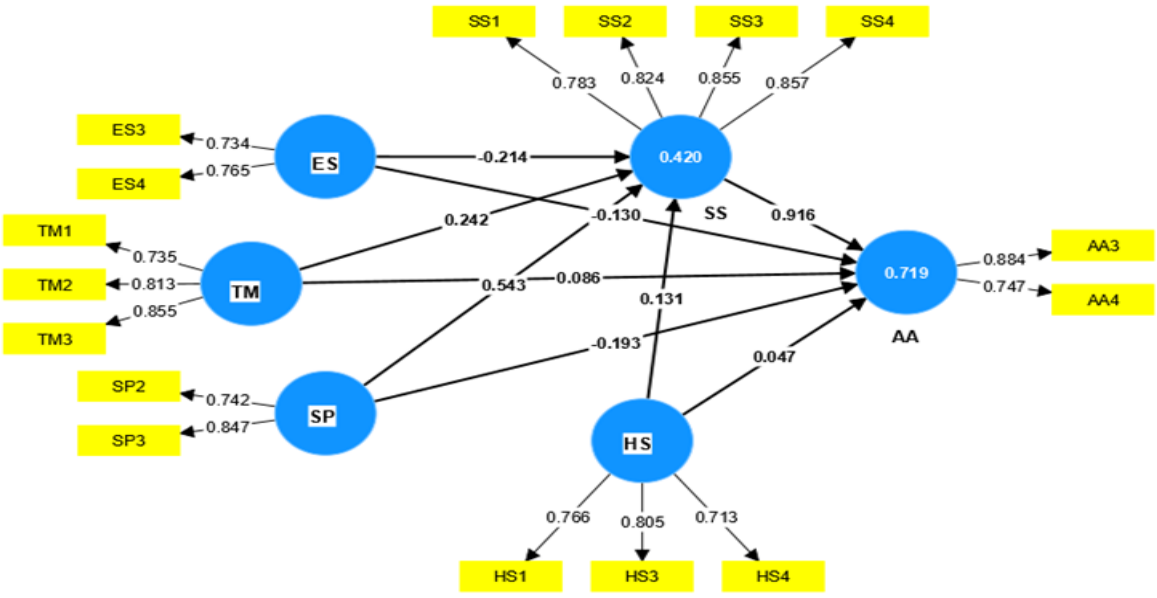

Figure 2: The results of path coefficients

Correlations among students' characteristics, SRL strategies, satisfaction and academic achievements

In order to delve into the correlations among students' characteristics, namely gender, academic school years, number of MOOCs, and SRL strategies, as well as satisfaction and academic achievement, the Pearson correlation coefficient (or Pearson's r) was performed to test these relationships. The result shows that gender does not significantly influence online learning satisfaction, academic performance, or self-regulated learning (SRL) strategies (p>.05). These confirm Hypotheses 1, 2, and 3.

Regarding the correlation between prior educational experience and satisfaction, measured by the number of school years and numbers of MOOCs, the findings are more conflicting. The correlation between school years and online learning satisfaction was supported (r=-181, p<.001), while the number of MOOCs and satisfaction were not correlated (p>.05), therefore Hypothesis 4 was partially conformed.

Regarding the correlation between prior educational experience and academic achievements, the results presented an interesting contrast. While there is a positive correlation between numbers of MOOCs with academic performance (r=.149, p<.05), a significant negative correlation is observed between the number of school years and online academic performances (r=-.264, p<.01).

Details can be seen in Table 10 below:

Table 10: Correlations among students' characteristics, SRL strategies, satisfaction and academic achievements

Pearson Correlation Coefficients							
		ES	TM	HS	SP	SS	AA
Gender	Pearson Correlation	0.067	0.055	-0.026	0.072	-0.045	-0.075
	Sig. (2-tailed)	0.324	0.413	0.699	0.283	0.509	0.263
	N	222	222	222	222	222	222
School years	Pearson Correlation	0.005	-0.116	-0.088	-0.012	-.181**	-.264**
	Sig. (2-tailed)	0.937	0.082	0.190	0.853	0.006	0.000
	N	226	226	226	226	226	226
Number of MOOCs courses	Pearson Correlation	0.013	0.100	0.104	0.080	0.129	.149*
	Sig. (2-tailed)	0.851	0.134	0.118	0.230	0.053	0.025
	N	227	227	227	227	227	227
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

4.2 Qualitative Findings

Other factors affecting students' satisfaction and dissatisfaction in MOOCs

The results from the open-ended questionnaires of the 227 participants were analysed using thematic analysis (Braun and Clarke, 2006). Three overarching themes related to students' satisfaction emerged from the data, namely Flexibility and Convenience, Quality of Learning Experience, and Collaboration and Interaction. In particular,

Flexibility and Convenience

This theme involves students' preferences for self-paced learning (124 out of 227 responses), flexible time (146 responses), opportunities for multitasking (92 responses), and learning where they want to (151 replies). This theme reflects how online learning adapts to individual lifestyles and preferences.

Quality of Learning Experience

This theme encompasses codes such as multitasking opportunities and knowledge enhancement. For opportunities to multitask in learning, 92 of them explained that learning in MOOCs helped them engage more in multiple activities simultaneously, such as watching the clips and reading the transcripts at the same time; this enhanced their learning efficiency. Moreover, 54 out of 227 participants noted that this learning mode enriched much of their knowledge.

Interactivity and Support

This theme was developed from codes such as collaborative opportunities, mentor-student interaction, and student-student interaction. Fifty-nine students noted that they had opportunities for co-learning with their peers, especially when they decided to choose a place to study together. Although recognizing the importance

of support from mentors and peers, not many of them confirmed that learning in MOOCs benefited their interactions with these sources (22 and 33 out of 227 responses respectively).

Figure 3 below depicts these codes to emphasize the weight of significant factors regarding students' satisfaction when learning in MOOCs:

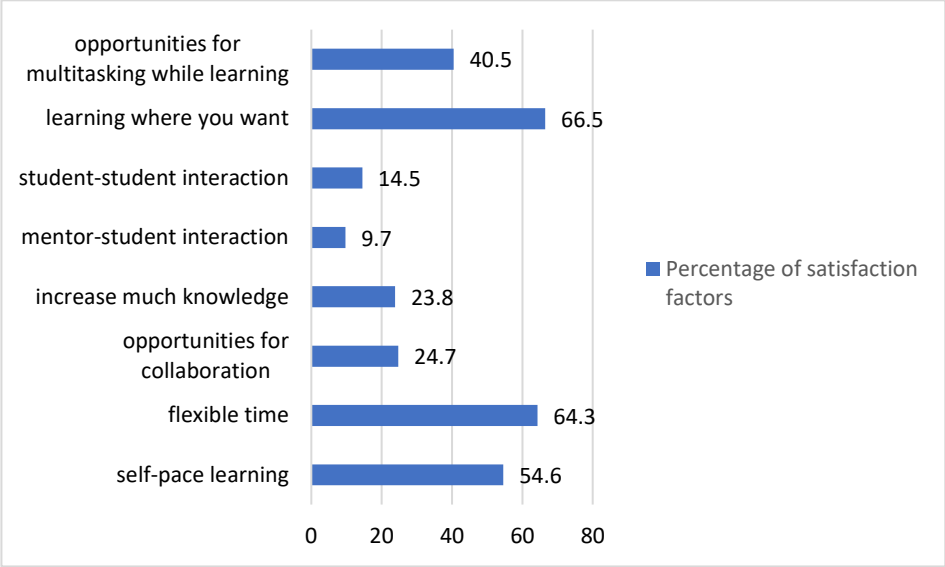

Figure 3: Satisfaction factors

Nevertheless, learning in MOOCs also caused hindrance for students. We conducted a thematic analysis of the data from the open-ended questionnaire survey and developed themes that encapsulate factors that hinder students' learning in MOOCs. Six themes emerged from the analysis, including Technological Challenges, Course Design and Structure, Interpersonal Dynamics, and Ethical and Motivational Concerns.

Technological Challenges

This theme was generated from the codes Internet Connection Issues and Technology Proficiency. Internet connection issues refer to the internet accessibility or stability which can impact course participation. Ninety out of 227 responses shared this view while complaints on the ability to use computers and related technologies on their course experience was just 22 out of 227 responses.

Course Design and Structure

Many students agreed that the tasks to be done in their MOOC courses were challenging and demanding compared to their levels (89 comments). Thirty of them shared that they face difficulties in the course contents and 15 responses admitted their insufficient language capacities, and so they often consulted Google translation. They wrote:

> *"I asked the teacher or Google search to find information or translate it into Vietnamese when I don't understand what the lesson is about." (Student 25)*

> *"I can't catch the clip if I don't watch it, but if I don't read it, it's a bit difficult to understand" (Student 31)*

In addition, one third of the total surveyed students complained about the time limit constraints set by the school. They said:

> *"Deadlines on MOOCs are for a total of 3 months, but the school will give deadlines for each course and we usually have to complete them 1 week before the deadlines for courses on Coursera, so we have to rush up for deadlines, which is quite tiring" (Student 2).*

Some students also expressed discontent with the MOOCs they took:

> *"After the lesson, there is no summary like in the classroom, so sometimes I cannot summarize the lesson completely. In addition, there is no review like when I took basic English courses" (Student 125).*

Interpersonal Dynamics

Similar to previous research interaction deficiency in online learning (Wu, Tennyson and Hsia, 2010), 136 researched participants indicated that the quality and frequency of interactions between mentors/ instructors and students are not as high as their expectation. Also, peer learning is not highly appreciated when they learned in MOOCs:

> *"I rarely ask mentors because I feel shy, or sometimes when I text to ask, I'm only given suggestions on which article or course to find the answer in, but I don't get a straight answer" (Student 50).*
>
> *"I don't often ask my friends but usually find more information online. Sometimes I watch clips and read transcripts to understand the lesson better" (Student 67).*

It can be seen that MOOCs created chances for students to self-regulate their learning, especially when they had to manage their learning time, or find out appropriate and effective learning strategies for themselves. Although students considered this was a limitation on their interactions with mentors and peers, this sharing has once again emphasized the crucial role of students' self-regulated learning in higher education (Yen, Nhung and Le, 2024) and in MOOCs (Littlejohn, et al., 2016; Al Mulhim, 2020).

Motivational Concerns

This theme was a significant feature that most students acknowledged when being asked "What factors are you not satisfied with in online courses?" Low motivation is a common consensus among students about difficulties they encountered while learning in MOOCs. Approximately 55% of surveyed students said that they felt isolated in learning.

> *"I don't feel very motivated when I have to study alone, sometimes I forget that I have a course on Coursera." (Student 3)*
>
> *"I remember there was a course I was taking on Coursera. If it weren't for a classmate asking me how far I was studying, I probably wouldn't have finished it on time (Student 11).*

This is not a surprising finding since learning in MOOCs requires a high self-motivation to achieve learning outcomes (Aljaraideh, 2019; Watted, 2023).

Figure 4 below illustrates these codes to highlight the weight of significant factors regarding students' dissatisfaction when learning in MOOCs:

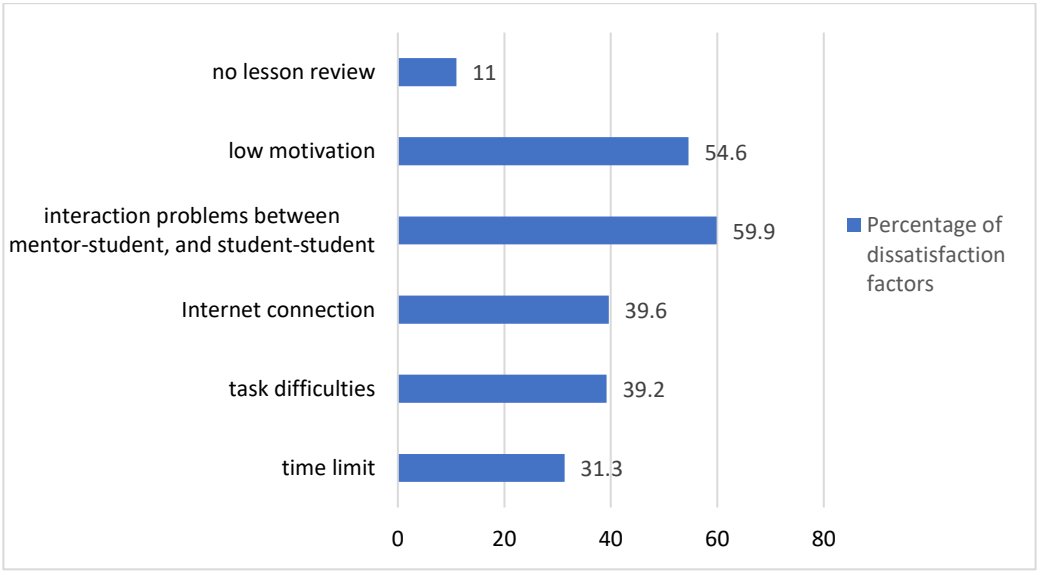

Figure 4: Dissatisfaction factors

5. Discussions

This study supported previous studies indicating that gender did not affect students' satisfaction in online learning (Harvey, Parahoo and Santally, 2017; Yu, 2021), hence Hypothesis 1 was confirmed. However, it was

inconsistent with a study by Dinh, et al. (2022) in which the participants came from non-English majors, hence the difference may come from students' disciplines.

In examining the correlation of gender and academic performances, the result revealed that English major students did not believe the influence of gender on their learning results. This finding was also supported by Adigun, et al. (2015) and Lim, et al. (2006). However, it ran counter to the study by Du, et al. (2019) which found that female students majoring in Science and Sports, and Liberal Arts performed better in online learning environments.

Gender issue in relation to SRL strategies was also found in previous research (Virtanen and Nevgi, 2010; Bai, Shen and Mei, 2020; Liu, et al., 2021), but was not supported by the current study or Dinh, et al. (2022). A plausible explanation for this dichotomy may be from the learning mode and students' characteristics per se. The participants from other studies are non-English majors (Liu, et al., 2021; Virtanen and Nevgi, 2010), while the study by Bai, Shen and Mei (2020) was conducted in conventional settings. It can be inferred from these findings that gender is not a concerning matter of satisfaction, academic outcomes, and SRL strategies for English disciplines in MOOC modality.

Turning to the interrelations between prior knowledge and other study constructs, the current study confirmed the correlation of school years and numbers of MOOC courses and satisfaction and academic achievements. This finding was not in line with other previous studies (Yukselturk and Bulut, 2009). In addition, the number of students' academic years and satisfaction were also correlated, but weakly and negatively ($p=0.006$, $r=.181$). This means that, as the number of academic years increases, the students' satisfaction with MOOCs tends to decrease, but the relationship is weak. A plausible explanation for this is that MOOCs often lack the personal interaction that traditional courses offer. For senior students who may value more in-depth discussions and interactions with peers and instructors, the limited interaction in MOOCs might negatively impact their satisfaction. Surprisingly, the number of previous MOOC courses was not correlated with satisfaction. This finding sounds conflicting since school years and numbers of MOOCs are quite interrelated. Examining this in more detail showed that the participants studied different courses and their MOOCs courses were also different due to a change in curriculum, although they were all English majors. It is probable that course difficulty levels affect their satisfaction.

In contrast to previous studies (Holcomb, King and Brown, 2004; Wang, Shannon and Ross, 2013), the current study and the work by Cho and Kim (2013) found no correlations between prior knowledge (i.e., number of school years and numbers of MOOCs) and SRL strategies. A possible reason for this may be that they were not trained in these skills. This may well explain the reason why they perceived the positive effects of SRL strategies on their satisfaction and academic achievements in the algorithm and bootstrapping analyses.

In particular, the investigated SRL strategies, namely environmental structuring, help-seeking, strategic planning, and time-management were perceived having positive effects (see Table 9 on students' satisfaction and academic achievements in MOOCs. Although these were students' perceived effects, this would affect their use of them in their learning (Versteeg, et al., 2021).

This study did not support a study by Kuo, et al. (2013) indicating that metacognitive strategies did not predict student satisfaction and achievement. Differences may come from the students' characteristics as, for example, most are over 25 in Kuo, et al. (2013). However, it was in line with Puzziferro (2008) showing time management and environmental structuring having a positive correlation with levels of satisfaction or metacognitive strategies having a positive impact on student satisfaction in online learning (Ejubović and Puška, 2019).

The study was supported by prior research (Jansen, et al., 2017; Kizilcec, et al., 2017; Littlejohn, et al., 2016), showcasing that SRL strategies, such as time management, strategic planning, and help seeking were significant positive predictors of student satisfaction and attainment, particularly academic achievement in MOOCs. However, it contradicted a study by Mahmoodi, Kalantari and Ghaslani (2014) which indicated no significant relationship between the use of SRL strategies and English achievement. Interestingly, the participants of the study by Madmoodi, Kalantari and Ghaslani (2014) were from on-campus classes.

The qualitative findings reveal several new insights into factors affecting students' satisfaction and dissatisfaction with MOOCs, adding depth to previously identified factors and providing a more comprehensive understanding of the student experience. First, the theme of flexibility and convenience is reinforced, confirming previous studies that highlight the importance of self-paced learning and flexible timing in enhancing student satisfaction (Watted and Barak, 2018). The current study adds that the ability to multitask and learn from any

location further enhances the convenience of online learning, allowing it to adapt to individual lifestyles and preferences.

The quality of the learning experience remains a critical factor. Previous studies emphasized the quality of course content and interactive components as crucial for engagement and satisfaction (Margaryan, Bianco and Littlejohn, 2015; Wang, et al., 2022; Díez-Arcón, 2023). The current study confirms these findings and highlights that the ability to engage in multiple activities, such as watching video clips and reading transcripts simultaneously, significantly boosts learning efficiency and satisfaction.

Support systems and feedback are also pivotal. Strom, Margolis and Polat (2019) and Wang, et al. (2022) noted the importance of peer interaction and timely instructor feedback for creating a supportive learning environment. The current study supports these findings, emphasizing that collaborative opportunities and co-learning with peers are valuable, although many students did not feel that MOOC learning significantly benefited their interactions with mentors and peers.

New insights from the study highlight technological challenges, such as internet connection issues and difficulties using technology, as significant barriers to course participation. These challenges were not highlighted in previous studies but are crucial in understanding the full range of factors affecting student satisfaction.

The design and structure of courses also emerged as important factors. While previous studies pointed to rigid deadlines contributing to stress and dissatisfaction (Ihantola, et al., 2020), the current study provides more nuance, identifying challenging tasks, demanding course content, language barriers, and institution-set deadlines as additional sources of dissatisfaction.

Interpersonal dynamics remain a significant concern. Previous studies indicated that limited interactions with instructors and peers lead to isolation and disengagement (Zhang, Chen and Phang, 2018; Garg and Goel, 2021; Wang, 2021). The current study confirms this, further detailing that the quality and frequency of interactions often did not meet student expectations, resulting in significant feelings of isolation.

Lastly, motivational concerns are a recurring theme. Low motivation and lack of engaging content were highlighted by previous studies as factors that hinder focus and commitment, leading to higher dropout rates (Azhar, et al., 2023; Cilliers, Twinomurinzi and Murire, 2023). The current study echoes these concerns, noting that many students struggle to stay motivated without the structure of a traditional classroom environment.

Some theoretical and practical implications can be drawn on the above findings in the context of MOOCs and similar online learning environments. First, the more students experience MOOCs, the more they perceive positive correlations with their academic achievements. However, this perception goes in the opposite direction (see Table 8, the correlations of school year and satisfaction and academic achievements were negative, r = -.181 and r = -.264 respectively) among English majors when they faced difficult MOOCs. It can be inferred that if students are not supported or do not know how to tackle task difficulties when learning in MOOCs, their learning outcomes can be fruitless. In this case, SRL skills can help enhance their academic outcomes (Pintrich, 2000).

Second, although the students showed a contradictory correlation between years of studying and satisfaction and academic achievements, their perceptions of the perceived values of the effects of SRL strategies on their academic performances and satisfaction are positive. This can be postulated that training students to use these SRL skills would benefit their learning in MOOCs.

6. Conclusions and Limitations

The present study explored the correlations between students' characteristics (gender, school years, and numbers of MOOCs) and satisfaction and academic performances, and investigated the influence of SRL strategies on these two endogenous variables in MOOC learning modality. The quantitative results showed that SRL strategies were perceived to have a positive impact on satisfaction and learning results. Particularly, the perceived effect of strategic planning on satisfaction was fairly large (f-square = 0.256). The proposed research model has confirmed the significant contributions of SRL strategies, namely environmental structuring, help-seeking, strategic planning, and time management to students' satisfaction and academic outcomes in MOOC learning environments in higher education contexts in the Mekong Delta of Vietnam. Most of the surveyed students in this study are experienced in learning in MOOCs (177 out of 237 have learned three MOOCs), but none of them have been trained for SRL strategies before. Hence, this study has implications for an SRL training program for MOOC learners, integrating self-regulated learning strategies into MOOCs, for example. This could

involve designing course materials and activities that encourage and support these strategies. Additionally, the study emphasizes the benefits of flexible learning times, self-paced study options, and the ability to choose study locations, while also identifying challenges such as limited social interaction, poor internet connectivity, and low motivation. These insights contribute to the broader field of education by underscoring the crucial role of SRL strategies in the success of MOOCs.

Pedagogically, the study provides valuable implications for integrating SRL strategies into MOOC design and instruction. It suggests that incorporating these strategies into course materials and activities can enhance student satisfaction and performance. Training students in SRL techniques can help them manage their learning processes more effectively, overcome challenges, and achieve their academic goals. This is particularly relevant for English major students who often lack direct interaction with instructors and peers, making SRL strategies essential for their success in an online learning environment.

Methodologically, the study employs a mixed-methods design, utilizing both quantitative (SPSS and PLS-SEM) and qualitative (thematic analysis) approaches to provide a comprehensive analysis of the data. This approach allows for a deeper understanding of the effects of SRL strategies on student outcomes. Furthermore, the study proposes future research directions, including investigating additional SRL strategies and incorporating a larger, more diverse sample. It also suggests exploring the unique challenges faced by different academic disciplines in MOOCs to offer more tailored solutions for improving online learning experiences. These methodological contributions provide a solid foundation for further research and practical applications in the field of online education.

The research acknowledges some shortcomings. The first limitation is that it is based on a sample of English majors from a single private university. Hence, the generalization to other contexts should be cautious although the participants' detailed demographics have been clearly depicted. Second, even though the study has successfully indicated the perceived effects of SRL strategies on satisfaction and academic results, a round-up of students' actual use of these SRL strategies in their learning in MOOCs would help to confirm these effects. For instance, longitudinal studies to track the long-term effects of SRL strategies on learning outcomes in MOOCs might also be a promising direction for future research. Last, but not least, other SRL strategies with a larger sample size from diverse universities should be included so that a clearer picture of students' perspectives of the effects of SRL strategies on their learning outcomes can be mapped.

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Technostress Impact on Educator Productivity: Gender Differences in Jordan's Higher Education

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Abstract: This research examines the effects of technostress on educators' productivity within Jordan's higher education sector, highlighting gender differences. Technostress, characterized by techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, adversely affects productivity. The study gathered data from 500 educators through a structured online survey, achieving a 73% response rate. Analysis revealed that technostress generally decreases productivity, with a more pronounced negative impact on male educators than females. The findings underscore the necessity for targeted interventions to mitigate technostress, particularly among male educators. Strategies recommended include training programs, policy adjustments, and organizational support to enhance the digital teaching environment. This study contributes to the understanding of technostress in Jordanian educational settings. It offers practical recommendations for enhancing e-learning practices and improving the overall educational experience and productivity in Jordan's higher education sector.

Keywords: Techno-overload, Techno-invasion, Techno-complexity, Techno-insecurity, Techno-uncertainty, Productivity, Education

1. Introduction

The widespread adoption of technology in daily life has led to increased use of information technology and the Internet, resulting in a phenomenon known as technostress. Due to this phenomenon, higher education (HE) academics face unique challenges in Jordan. The rapid shift to online and blended learning models, driven by the COVID-19 pandemic, has placed unprecedented demands on educators (Bahamondes-Rosado et al., 2023). They grapple with increased digital workloads, continuous adaptation to new technologies, and the pressure to maintain educational quality in a virtual environment (Derra et al., 2022; Fernández-Fernández et al., 2023). These challenges highlight the specific needs of HE academics in Jordan, such as enhanced digital literacy, effective stress management strategies, and institutional support to balance online and offline teaching responsibilities.

Integrating Information and Communication Technology (ICTs) into the education sector in Jordan presents unique challenges for HE academics. Beyond the shift to online and blended learning models, they need robust digital infrastructure, innovative online teaching methodologies, and more comprehensive institutional support. These needs are critical in ensuring effective online education and mitigating the negative impacts of technostress. Our study is particularly justified as there is a need for more research focusing on the Jordanian context in this domain. By exploring the specific challenges and needs of HE academics in Jordan, this study seeks to provide valuable insights into technostress and its impact on productivity within this unique setting. Such insights are crucial for developing effective strategies to enhance the digital learning environment in Jordan, ultimately benefiting educators and learners alike.

Technostress refers to the stress experienced by individuals who regularly use information systems and technological tools (Upadhyaya & Vrinda, 2021). The negative impacts of technostress can include anxiety, mental fatigue, physical ailments, technophobia, resistance, intolerance, perfectionism, terror, exhaustion, memory loss, and sleep disorders. In addition, technostress can adversely affect the business environment, leading to job dissatisfaction, decreased employee performance, reduced organizational commitment, and decreased intention to stay. Smeltzer (1987) concluded that technology-related stress can devastate organizations, including increased turnover rates, customer complaints, difficulties and problems with recruitment, and harm to the organization's internal and external image.

The COVID-19 pandemic has significantly increased the use of information systems and the Internet, with online services becoming more prevalent due to reduced face-to-face activities. However, this has also led to greater technostress and its negative consequences (Nascimento et al., 2024). Previous research has shown that

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technostress is a destructive phenomenon associated with the excessive use of ICTs in various fields, including online education (Upadhyaya & Vrinda, 2021). Understanding the harmful effects of technostress in online education is crucial for educators and learners, particularly given that online education is projected to become the conventional mode of education by 2025. Although significant research has been conducted on technostress in academic circles, more studies need to focus on the specific context of Jordan. In Jordan, technological advancements and integration of ICTs (Information and Communication Technologies) into the education system have become commonplace. As a result, this study seeks to investigate how technostress adversely affects educators' productivity in Jordan and explore the potential mediating role of demographics. The primary objective is to identify the key sources of technostress and develop effective strategies for optimizing the benefits of online education by designing conducive work environments.

In contemporary society, the integration of information technology has touched almost every aspect of daily life, ranging from communication and data processing to problem-solving, marketing, and entertainment. The latest figures from the Telecommunications Regulatory Commission (TRC, 2019) in Jordan show that over 9 million people use the Internet, reflecting a remarkable 108% increase over the last five years. The development of e-technologies has witnessed the advent of e-commerce, e-mails, e-government, and, most recently, e-education (Palvia, 2013; Sethi et al., 2021). E-education has transformed the traditional approaches to teaching and learning. Online learning was introduced in the 1990s to provide remote individuals and those seeking convenience to overcome physical educational barriers. In the wake of the COVID-19 pandemic, universities and other educational institutions have increasingly relied on online learning to maintain their operations and financial performance (Palvia et al., 2018). By identifying the most influential techno stressors and developing strategies to design the workplace to maximize the advantages of online education, this study could provide valuable insights for policymakers in Jordan. These insights could help policymakers design effective interventions to minimize the negative impact of technostress on educators and maximize the advantages of online education, ultimately leading to increased productivity and satisfaction for educators and learners.

In today's world, technology has become necessary and is believed to simplify work and make it more convenient. Although the advancement of technology has the potential to improve performance and maximize profits in the education sector, it also has negative implications, such as technostress, social anxiety, social phobia, and social media addiction. Researchers have conducted valuable studies to explore the adverse perceptions and harmful impacts of technostress in various fields. Pullins et al. (2020) and Alam (2016) have investigated the negative effects of technostress on sales professionals, healthcare workers, and crew productivity in the aviation sector, respectively. While many studies focus on technostress in an organizational context, there needs to be more research on technostress among lecturers and students in the education sector (Fitzgerald, 2021). Universities must capitalize on the Internet and other technological advancements for online teaching. Volery and Lord (2000) identified the three essential success factors in online delivery methods at universities: technology, lecturer, and prior use of technology.

This study is concerned with the psychological stress educators in the education sector experience due to information and communication technology (ICT) and its impact on their productivity. Previous studies have explored the relationship between technostress and productivity, but little attention has been given to the moderating effect of demographic variables in developing countries. Therefore, this study aims to examine the influence of technostress on educators' productivity in Jordan, a developing country, and investigate the change in relationship direction and significance with the effect of gender variables. Most studies have focused on the relationship between technostress and educators' productivity in face-to-face communication. However, this study measures the relationship in the context of online/blended learning, which is prevalent due to extreme events like COVID-19 or wars that impose another lifestyle. With the sudden instruction to work from home (WFH) by many educational institutions during COVID-19, some researchers have suggested that the relationship has been reversed. Irawanto et al. (2021) found that during COVID-19, WFH reduced the stress associated with using technology in Indonesia and enhanced the quality of life.

Additionally, remote working or telecommuting is more likely to promote job satisfaction, organizational commitment, and employee productivity (Gibbs et al., 2021; Farmania et al., 2022). This study focuses on the education sector in Jordan, providing context-specific insights into the relationship between technostress, gender, and productivity. This contributes to the existing literature by considering this sector's unique characteristics and challenges. The findings can guide human resources management strategies and interventions tailored to the education sector, considering the specific needs and experiences of service providers in Jordan.

2. Literature Review

2.1 Technostress: Definitions and Features

In the 1980s, the concept of technostress was introduced by Craig Brod, a clinical psychologist who believed that technostress is a modern disease arising from the inability to cope with information systems healthily (Gaudioso et al., 2017). Brod identified two distinct but related ways technostress manifests: struggling to accept computer technology and over-identification with computer technology. However, Al Masri et al. (2023)) noted that people who overly identify with computer technology may lose the ability to feel and interact with others. Champion (1988) defined technostress as the "price of using technology" and criticized Brod's view of considering it a "serious illness." He believed that technostress arises because some individuals lack the skills to cope with new technologies rather than because of the technology itself. Weil and Rosen (1997) defined technostress as any negative impact on attitudes, thoughts, behaviors, or body physiology caused directly or indirectly by technology. They found that users of technology experience technostress in both work and home settings.

According to Isiakpona & Adebayo (2011), technostress is described as a state that arises when individuals are required to adapt to new technology, especially in cases where the equipment, support, or the technology itself is insufficient. This definition and similar ones imply that technostress is synonymous with stress from technology-related factors (Agboola & Olasanmi, 2016). Technostress is triggered by accelerated technologies, arrangements between these systems, and the continuous requirements from organizations, customers, and the social environment (Arnetz & Wiholm, 1997). Over the past decade, the pace of work has changed dramatically due to information communication technologies and their accompanying consequences, leading to technostress for organizations and their workers through misuse, overuse, and abuse (Gaudioso et al., 2017). ICTs have introduced unwanted risks, and organizations have experienced notable adjustments in their structures and competition (McAfee, 2006).

Tarafdar et al. (2007) identified five key dimensions of technostress and techno-stressors: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Techno-overload relates explicitly to situations where users of information and communication technologies (ICTs) are compelled to work faster and for longer durations, handle multiple tasks simultaneously, and process substantial amounts of information within limited timeframes. This can result in physical and psychological difficulties such as tension, stress, discomfort, and memory loss (Agboola & Olasanmi, 2016). Karr-Wisniewski & Lu (2010) further elaborate on techno-overload, identifying system feature overload, information overload, and communication overload as its three main dimensions.

Techno-invasion refers to the intrusive impact of ICTs that blur the distinction between work and personal domains. This phenomenon creates situations where users can be contacted and reached anytime. Consequently, individuals experience constant pressure to stay connected and be available for work-related matters, resulting in heightened stress and frustration. The continuous influx of tasks and requests contributes to the overwhelming feeling experienced by workers (Agboola & Olasanmi, 2016). Techno-complexity refers to the state where the intricate nature of ICTs leaves users feeling incompetent in their proficiency. It compels them to invest time and energy into acquiring knowledge and comprehending different aspects of ICTs. According to Sweeney & Summers (2002), techno-complexity can be described as situations where employees experience a sense of inadequacy in dealing with ICTs due to their advanced and unfamiliar nature, which surpasses their existing skill set.

Techno-uncertainty pertains to situations where users face unsettled feelings due to the constant changes and advancements in ICTs. This uncertainty arises from the ongoing need to learn and educate themselves about new technologies. While individuals may initially be enthusiastic about acquiring new technological skills, continuously introducing unfamiliar and updated technologies can lead to hesitancy and frustration. Recent studies, such as those conducted by Nisafani et al. (2020) and Farmania et al. (2022), have reinforced the significance and presence of these techno-stressors.

2.2 Technostress across Different Work Settings

Exploring technostress across different work settings reveals its varying impact on job satisfaction and performance. Studies such as those by Al-Fudail & Mellar (2008), Agboola & Olasanmi (2016), and Pullins et al. (2020) highlight the challenges faced by professionals in different sectors, emphasizing the need for customized strategies to manage technostress. Al-Fudail and Mellar (2008) investigated the impact of technostress on teachers and explored the drivers, consequences, and coping mechanisms associated with technostress in

teaching. They found that teachers experience technostress in the classroom due to a lack of fit between the user and the technological environment and a lack of necessary support and training. This mismatching leads to psychological consequences such as annoyance, irritation, and frustration and can negatively impact teachers' job satisfaction and performance. The authors recommend that decision-makers address environmental factors contributing to technostress and encourage teachers to adopt appropriate coping strategies such as more training, exercising, and then using and changing teaching styles. They also suggest that technostress should be incorporated into economic equations to calculate hidden costs and maximize the value of ICT investments in education. Agboola and Olasanmi (2016) examined the negative impact of technostress on auditors' performance in developing countries. They suggested that boosting ICT training and stress management involvement could be protective measures to limit the impact of technostress.

Pullins et al. (2020) found that sales professionals experience high levels of technostress in their daily tasks, leading to lower job satisfaction and increased role stress. They suggest that job commitment may be a moderating variable that relates negatively to job satisfaction. Hung et al. (2015) applied the law of diminishing returns theory to their study. They concluded that while using technology may promote productivity to some extent, excessive utilization of technology can result in notable decreases in productivity among mobile phone users. Tarafdar et al. (2007) proposed a research model to investigate the impact of technostress on productivity. They found that techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty negatively impact user productivity. The effect of demographic variables on this relationship should be explored in different domains. These studies suggest that technostress is a common issue in various work settings and negatively impacts individuals' job satisfaction and performance. Proper training and support and appropriate coping strategies can help individuals deal with technostress and maximize the benefits of technological advancements in the workplace.

2.3 Technostress and Productivity within the Context of Remote Working

Remote work, especially during the COVID-19 pandemic, has heightened the prominence of technostress. Research shows that its impact on productivity varies depending on the nature, demographic variables, and digital literacy. Remote work has become increasingly popular recently, particularly due to the COVID-19 pandemic. Many businesses and universities have adapted to remote work, and the trend is expected to continue. While remote work offers numerous benefits, such as flexibility and work-life balance, it also has challenges, particularly regarding technostress and productivity. Technostress refers to the stress caused by using technology in the workplace. With the increased use of technology in remote work, technostress has become a significant issue for many workers. One study found that technostress has increased during the COVID-19 pandemic (Farmania et al., 2022). However, the relationship between technostress and productivity is complex and can be influenced by various factors.

One such factor is the nature of the job. For instance, a study by Choudhury et al. (2019) found that remote work improved productivity by 4.4% for the US patent and trademark office. However, this increase in productivity was mainly due to the simplicity of the tasks. In contrast, Kunn et al. (2021) found that remote work had a negative impact on the productivity of professional chess players, whose jobs require high cognitive demands and extensive training programs. In addition to the nature of the job, other factors that can impact the relationship between technostress and productivity include demographic variables such as age and gender and digital literacy. For instance, research has shown that males tend to experience more technostress than females, younger individuals tend to experience more technostress than older ones, and users with lower digital literacy tend to experience more technostress than those who are more proficient with digital technologies (Tarafdar et al., 2007; Tarafdar et al., 2011; Ragu-Nathan et al., 2008).

Remote work can also impact the productivity of workers with children at home. A study by Gibbs et al. (2021) found that workers with children at home are less productive than those without. However, other factors, such as increased time spent in extended meetings and reduced one-to-one communication, can also reduce productivity, as Gibbs et al. (2021) observed. Similarly, technology can lead to both technostress and productivity challenges in education. The European Commission's Digital Learning Action Plan (2018) emphasizes the importance of digital technologies in education and highlights the need for educational institutions to integrate these technologies into their frameworks. However, using digital technologies in education can also lead to technostress. Berg-Beckhoff et al. (2017) found that workers who use digital technologies in education risk experiencing technostress due to the increased workload and the need to handle large amounts of information quickly and accurately.

University lecturers and professors come from diverse backgrounds with different skill levels and competencies. Those with less ICT literacy are likelier to experience higher technostress levels and reduced productivity. The nature of their work involves instructional activities, interactions with students, and administrative tasks, each impacted by the use of technology (Tarafdar et al., 2007; Tarafdar et al., 2011; Ragu-Nathan et al., 2008). These studies highlight the complex relationship between technostress and productivity in remote work. The nature of the job, demographic variables, digital literacy, and work-life balance can all influence the relationship between technostress and productivity. Understanding these factors can help organizations and individuals manage technostress and improve productivity in remote work settings.

2.4 Technostress in Jordanian Higher Education

Technological advancements and integrating ICTs (Information and Communication Technologies) into the education system have become commonplace in Jordan. Jordan's Ministry of Education has recognized the importance of integrating technology into the education sector and has implemented several initiatives to support this goal. However, the rapid pace of technological change has also led to increased technostress among educators in Jordanian higher education. Jordanian educators face challenges including increased digital workloads, continuous adaptation to new technologies, and maintaining educational quality in a virtual environment (Derra et al., 2022; Al Masri et al., 2023; Fernández-fernández et al., 2023). These challenges highlight the specific needs of HE academics in Jordan, such as enhanced digital literacy, effective stress management strategies, and institutional support to balance online and offline teaching responsibilities. This study aims to investigate how technostress adversely affects educators' productivity in Jordan and explore the potential mediating role of demographics. By understanding educators' unique challenges in the Jordanian context, this study offers valuable insights for policymakers and educational institutions to enhance the digital learning environment. Implementing the recommended strategies can help optimize the benefits of online education, ultimately advancing the e-learning area in Jordan's higher education.

3. The Study Model and Hypotheses Development

The study refines its hypotheses to focus on the moderating role of gender in the technostress-productivity relationship. Acknowledging that men and women may experience and cope with technostress differently, it is hypothesized that gender significantly influences this relationship. According to the Job Demands-Resources (JD-R) model proposed by Bakker and Demerouti (2007), employee well-being and performance are influenced by job demands and job resources, both directly and indirectly. In this study, technostress is considered a job demand representing the challenges and negative aspects of technology use in the workplace. Technostress refers to the stress and strain individuals experience when they perceive a lack of fit between technological demands and their abilities, resources, or needs.

On the other hand, productivity, which measures employee performance, is influenced by job resources such as support systems, autonomy, and access to technology. These resources enable employees to manage technostress and maintain their productivity levels effectively. The study extends the JD-R model by examining the moderating role of gender, acknowledging that gender-specific factors can influence the relationship between technostress and productivity. It recognizes that gender may shape individuals' experiences, coping strategies, and perceptions of technostress, thus affecting how technostress impacts productivity among service providers in the education sector. By integrating the JD-R model with a gender perspective, the study provides insights into the interactive effects of technostress and gender on productivity, contributing to a more comprehensive understanding of the relationship between job demands, job resources, and employee outcomes.

Based on the theoretical framework and literature review, the study developed a model to examine the relationship between technostress and productivity in remote working and education. Established scales such as the Technostress Scale (Tarafdar et al., 2007) and the IT Stress Scale (Maier, 2014) were utilized to measure technostress. Similarly, productivity was assessed using validated scales such as the Work Productivity and Activity Impairment Questionnaire (WPAI) (Reilly et al., 1993) and the NASA Task Load Index (Hart & Staveland, 1988). Additionally, the study proposes that the relationship between technostress and productivity is moderated by gender. Technostress, characterized by techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, imposes significant demands on educators. These demands can lead to physical and mental fatigue, decreased job satisfaction, and lower productivity. As technostress increases, educators may find it more challenging to manage their workloads efficiently, maintain high-quality performance, and achieve their professional goals. Therefore, it is hypothesized that:

H1: *Technostress negatively impacts productivity in the context of online and blended learning.*

Research has shown gender differences in the experience and perception of technostress. Women tend to experience higher levels of technostress than men, possibly due to differences in technological self-efficacy, work-life balance, or organizational factors such as role expectations and support systems. On the other hand, men may employ different coping mechanisms or exhibit different levels of resilience in dealing with technostress (Bapna et al., 2017; Huang et al., 2019). Considering these potential gender differences in technostress experiences and coping strategies, this study anticipates that gender plays a significant role in moderating the relationship between technostress and productivity among service providers in the education sector, particularly in remote working and education. Therefore, it is hypothesized that:

H2: *Gender moderates the relationship between technostress and productivity, with males experiencing a more pronounced negative impact than females.*

The study's model, depicted in Figure 1, illustrates the proposed relationships between technostress, productivity, and gender as a moderating variable.

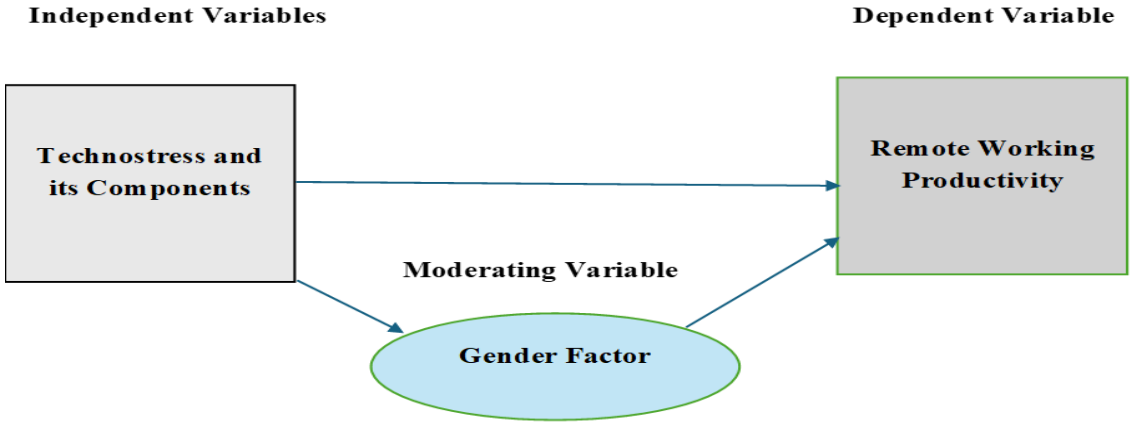

Figure 1: The study model

4. Research Methodology

This study aims to investigate technostress's impact on educators' productivity in Jordan's higher education sector, focusing on the moderating role of gender. The research design employs a quantitative approach, utilizing a structured online survey to collect participant data. Data were collected using a structured online survey distributed to educators in Jordanian higher education institutions. The survey included demographic questions, questions related to technostress, and questions assessing productivity levels. The survey achieved a 73% response rate, with 500 valid responses used for analysis. Technostress was measured using the Technostress Scale developed by Tarafdar et al. (2007). This scale includes five dimensions: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Each dimension was assessed using multiple items on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The reliability and validity of the scale have been established in previous studies (Tarafdar et al., 2007; Ragu-Nathan et al., 2008).

Productivity was measured using an adapted version of the Productivity Scale developed by Haynes (2007). The scale includes items that assess the perceived impact of technostress on productivity, such as the ability to complete tasks efficiently, the quality of work produced, and overall job performance. Responses were measured on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each item was carefully selected to reflect the core idea of each dimension and modified slightly to fit the context of HE academics in Jordan, ensuring cultural relevance and clarity for the respondents. The productivity measures were similarly adapted from validated scales to align with the context of our study, providing a comprehensive assessment of the impacts of technostress.

The research process adhered to ethical considerations. Participants were provided with information regarding the study's objectives, their voluntary participation, the option to withdraw at any point, and the confidentiality of their responses. Prior to completing the questionnaire, informed consent was obtained from all participants. The personal information of the participants was carefully safeguarded to ensure confidentiality and anonymity.

The collected data were analyzed using SPSS software. Descriptive statistics were used to summarize the participants' demographic characteristics and the technostress and productivity levels. Correlation analysis was conducted to examine the relationship between technostress and productivity. Multiple regression analysis was performed to test the hypotheses and examine the moderating effect of gender on the relationship between technostress and productivity.

5. Statistical Analysis

5.1 Descriptives of the Demographic Profile

The descriptives provide a data set in terms of participant demographics and adequate experience in answering questions to support the accuracy of the responses. Table 1 includes all the descriptive data on the participant's demographics, including gender, age, working position, working experience, and academic ranking. Table 1 shows that 72% of the respondents were male, while the remaining were female.

Most of the university academics were at their most productive age, as evidenced by the fact that 49.18% of respondents in the age category were between 36 and 45. Around two-thirds of respondents (69.23%) work as faculty staff members in the academic field. 46.15% of the respondents had worked at universities where they had employment and held positions for 11 to 15 years. According to academic rankings, 38.19% of university academics are associate professors. The respondents' demographic information is summarized in Table 1.

Table 1: Sociodemographic profile (N=364)

Demographic variable	Category	Frequency	Percentage
Gender	Male	262	72%
	Female	102	28%
Age	25-35 years old	28	7.69%
	36-45 years old	179	49.18%
	46-60 years old	140	38.46%
	61 years old and above	17	4.67%
Working position	Faculty staff	252	69.23%
	Department Chairman	68	18.68%
	Dean	34	9.34%
	Vice- president	8	2.20%
	President	2	0.55%
Work experiences	Five years or less	37	10.16%
	Between 6-10 years	59	16.21%
	Between 11-15 years	168	46.15%
	Between 16-25 years	84	23.08%
	More than 26 years	16	4.4%
Academic ranking	Full professor	98	26.92%
	Associate professor	139	38.19%
	Assistant professor	96	26.37%
	Lecturer	31	8.52%

5.2 Common-Method Variance (CMV)

Using Harman's (1967) single-factor test, we assessed the CMV to see if there was a common method variance. All items were included in the factor analysis with the unrotated factor option to see if the bulk of the variance could be attributed to a single component (Podsakoff et al., 2003). The analysis's findings indicate that a single factor accounted for around 28.77% of the variance that the model could explain. Common technique variance did not represent a significant issue in our investigation because the value was less than 50%. Further evidence that the model is unaffected by common method bias was provided by the deployment of the full collinearity test when the variance inflation factor (VIF) was less than 3.3 (Kock, 2015) (see Table 2).

We used structural equation modeling (SEM), specifically PLS-SEM using the SmartPLS 3.2.8 program, to evaluate our projected hypotheses (Ringle et al., 2017). According to Cepeda-Carrion et al. (2019), PLS-SEM analyses the relationships of latent variables evaluated by indicators for explanatory purposes. When complicated models are used in the research, PLS becomes a viable choice. Additionally, PLS-SEM may be applied in various research settings and offers excellent parameter estimation efficiency, as evidenced by the method's greater statistical power when compared to CB-SEM (Hair et al., 2017). PLS-SEM allows for simultaneous examination of the measures or constructs and the underlying structural model, making it excellent for exploratory, survey-based research (Hair et al., 2012). PLS-SEM performs variance-based estimation, which is different from other models that solely consider common variance while estimating parameters.

Moreover, a variance-based approach can be employed to conduct a comparative multigroupmultigroup analysis by considering a categorical moderator variable. Specifically, the measurement invariance assessment (MICOM) technique is utilized to examine the consistency in the measurement model, followed by a multigroup analysis to identify significant differences among groups concerning estimated parameters. To evaluate our hypotheses, we adopted a two-step procedure involving assessing the measurement model and, subsequently, the structural model (Hair et al., 2019).

5.3 Measurement Model Evaluation

5.3.1 Lower order construct (LOCs) (Stage-1)

To assess the measurement model in Partial Least Squares Structural Equation Modeling (PLS-SEM), it is crucial to evaluate the reliability, convergent validity, and discriminant validity of the constructs examined in the study. The two-stage approach involves estimating the PLS-SEM path model using the PLS algorithm in stage 1, employing 5000 subsamples without any sign change. The reliability of the outer measurement model was assessed using Dijkstra-Henseler's rho (rho_A) and composite reliability (CR).). The results presented in Table 2 demonstrate that all rho_A and CR values exceeded the minimum threshold of 0.7, indicating satisfactory reliability for all measurement items utilized in the study (Dijkstra & Henseler, 2015). Convergent validity was evaluated by examining the outer loadings of the items and the average variance extracted (AVE). As depicted in Table 2, the outer loadings of all items were above 0.7, and the AVE of each construct surpassed 0.5. Hence, the findings confirmed the convergent validity of the study (Hair et al., 2019).

Establishing the distinctiveness of each lower-order and first-order construct under investigation was essential to ensuring the accuracy and validity of the findings, thereby avoiding any potential confusion. Discriminant validity was assessed to determine the extent to which a construct is empirically distinct from other constructs.

Table 2: Construct reliability and validity.

Construct	Code	Loadings	VIF	rho_A	CR	AVE
Technostress	***Techno-overload***					
	Information Overwhelm	0.817	1.610	*0.780*	*0.867*	*0.685*
	Information Response Capacity	0.816	1.561			
	Work Impact from Technology Overuse	0.850	1.570			
	Techno-invasion					
	Digital Interruptions	0.859	1.758	*0.795*	*0.878*	*0.706*
	Work Interference by Digital Communications	0.839	1.766			
	Compulsion to Respond	0.822	1.547			
	Techno-complexity					
	Training Need for New Technologies	0.811	1.717	*0.798*	*0.876*	*0.702*
	Complexity of Work Due to Technology	0.835	1.514			
	Self-assessed Technical Proficiency	0.867	1.939			
	Techno-insecurity					

Construct	Code	Loadings	VIF	rho_A	CR	AVE
	Data Security Perception	0.729	1.403	*0.792*	*0.855*	*0.664*
	Work Impact from Security Concerns	0.843	1.623			
	Job Security Concerns Related to Tech Skills	0.867	1.559			
	Techno-uncertainty					
	Uncertainty in Using Digital Technologies	0.858	1.916	*0.828*	*0.896*	*0.741*
	Decision Difficulty for Digital Tools	0.875	1.920			
	Keeping Pace with New Technologies	0.849	1.783			
Productivity	Task Completion Efficiency	0.925	2.820	*0.922*	*0.941*	*0.801*
	Workload Management	0.870	2.715			
	Task Prioritization Ability	0.876	2.747			
	Focus and Concentration	0.906	2.456			

Fornell Larcker's criterion (Table 3) was employed to estimate cross-loadings at the indicator level, confirming that all indicators successfully loaded on their intended constructs (Hair et al., 2017). Furthermore, Henseler et al. (2015) proposed the Heterotrait-Monotrait ratio (HTMT) as a correlation measure to address cross-loading concerns. They recommended different threshold values for HTMT based on the conceptual similarity of the constructs, with a threshold of 0.85 for similar constructs. As shown in Table 4, all HTMT values were below 0.85, indicating sufficient discriminant validity for the model. In summary, the results of the PLS calculation model demonstrated satisfactory effectiveness and integrity for all constructs.

Table 3: Discriminant validity-Fornell-Larcker criterion

Construct	1	2	3	4	5	6
Productivity	0.895					
Techno-complexity	-0.483	0.838				
Techno-insecurity	-0.525	0.543	0.815			
Techno-invasion	-0.391	0.385	0.333	0.840		
Techno-overload	-0.451	0.413	0.527	0.344	0.828	
Techno-uncertainty	-0.544	0.517	0.568	0.362	0.430	0.861

Table 4: Discriminant validity-HTMT criterion

Construct	1	2	3	4	5	6
Productivity	-					
Techno-complexity	0.561	-				
Techno-insecurity	0.612	0.690	-			
Techno-invasion	0.457	0.485	0.434	-		
Techno-overload	0.531	0.525	0.687	0.435	-	
Techno-uncertainty	0.620	0.638	0.692	0.443	0.534	-

5.3.2 Higher-order components (HOCs) (Stage-2)

In stage 1 of the analysis, latent variable scores were introduced as new variables in the dataset and utilized as indicators for their corresponding higher-order components (HOCs) in stage 2. Two aspects were assessed to validate the higher-order model: (1) potential collinearity issues among the lower-order constructs and (2) the significance of the lower-order constructs. This study specified technostress as a reflective-formative higher-order construct comprising five lower-order components: techno-overload, techno-invasion, techno-

complexity, techno-insecurity, and techno-uncertainty. Potential collinearity concerns among the five lower-order components were examined to verify the higher-order hierarchical formative technostress model. The variance inflation factor (VIF), calculated as the variance ratio in a model with multiple terms to variance in a model with only one term, was employed for this purpose. A VIF value below 3.3 indicates no significant concerns regarding multicollinearity (Sarstedt et al., 2019). As depicted in Table 5, the VIF values were below the conservative threshold, indicating the absence of collinearity issues. Moreover, Table 5, Figure 2, and Figure 3 demonstrated that all indicator weights were statistically significant, affirming their relevance to the respective HOCs. Among the technostress components, techno-uncertainty exhibited the largest weight contribution (0.398, p<0.001), indicating its highest level of importance. It was followed by techno-insecurity (0.283, p<0.05), techno-complexity (0.218, p<0.05), techno-overload (0.215, p<0.05), and techno-invasion (0.208, p<0.05).

Table 5: Higher-order construct validity

HOC	LOCs	Outer weights	t-value	p-value	95% Confidence interval	VIF
Technostress	Techno-overload	0.215	2.319	0.021	[0.053;0.403]	1.459
	Techno-invasion	0.208	2.461	0.014	[0.048;0.369]	1.265
	Techno-complexity	0.218	2.135	0.033	[0.016;0.413]	1.644
	Techno-insecurity	0.283	2.734	0.006	[0.083;0.495]	1.887
	Techno-uncertainty	0.398	3.989	0.000	[0.188;0.568]	1.690

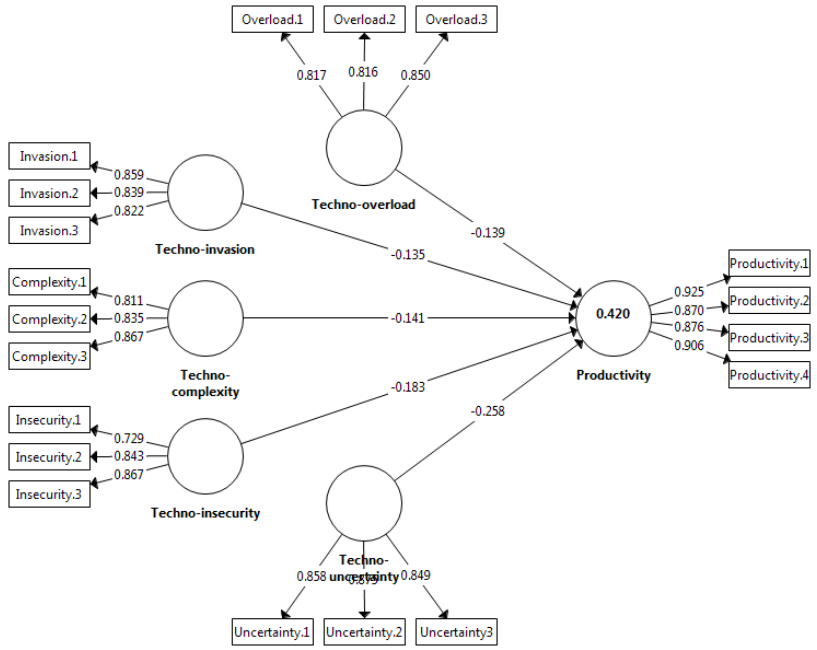

Figure 2: Measurement model (PLS) of the lower-order constructs (stage-1)

Figure 3: Measurement model (PLS) of the higher-order constructs (stage-2)

5.4 Structural Model Evaluation

After assessing the measurement model and ensuring its satisfactory performance, we evaluated the structural model. In this step, we examined various factors, including collinearity, R^2 value, SRMR value, Q^2 value, f^2 values, and significance of path coefficients. A significance level of 0.05 was used, and subsamples of 5000 were utilized as recommended by Hair et al. (2019). The collinearity test was conducted by analyzing the VIF value, and the results, as shown in Table 2, indicated that all estimations were below 3.3, indicating the absence of any multicollinearity issues in the PLS-SEM approach.

In terms of the findings, the R^2 value for productivity was determined to be 0.42, indicating that more than 42% of the variance in productivity could be explained by the significant factors identified in the study. The approach recommended by Hair et al. (2017) was utilized to assess the predictive relevance. Although the model fit measure of SRMR (Standardized Root Mean Residual) is not commonly used in PLS-SEM, the SRMR value of 0.059, which is below the threshold value of 0.08, suggests that the model fit was acceptable in this particular case, as per the guidelines of Hair et al. (2017). Based on the results presented in Table 6, Stone-Geisser's Q^2 values, calculated through cross-validated redundancy, were greater than zero, indicating that the model possessed predictive relevance, as Shmueli et al. (2019) suggested. Furthermore, the effect sizes of the outcome variables were examined using the f^2 metric, as shown in Table 6. Cohen's thresholds of 0.35, 0.15, and 0.02 were used to interpret the magnitude of effects, with values indicating large, medium, and small effects, respectively (Cohen, 1988).

The coefficients (β), confidence intervals (CI), and significance levels of the proposed hypotheses were also analyzed. The findings of the research hypotheses are presented in Table 7, revealing that technostress had a statistically significant negative impact on productivity (β = -0.648, p-value = 0.000). As a result, Hypothesis 1 was accepted based on the outcomes of the analysis.

Table 6: Model predictive capabilities

Constructs	R^2	Adj.R^2	f^2	Q^2	SUMMER
Technostress	-	-	0.725	-	-
Productivity	0.420	0.418	-	0.313	0.059

Table 7: Hypotheses testing

Structural path	Coef (β) and (T Statistics)	*P*-Values	Bias-corrected 95% CI		Remarks
			Lower	Upper	
H1: Technostress -> Productivity	-0.648 (17.819)	0.000	(-0.722, -0.576)		Supported

5.5 Multigroup Analysis (MGA)

In conducting the Multigroup Analysis (MGA), our sample was divided into male respondents (n = 2762) and female respondents (n = 102). While the female subgroup is smaller than the male subgroup and below the often-recommended size of 100, the robustness of our findings is supported by the successful completion of the Measurement Invariance of Composite Models (MICOM) procedure. This procedure, consisting of stages like configural invariance, compositional invariance, and ensuring equal means and variances across groups, was utilized to establish measurement invariance across the male and female groups. The results, as shown in Table 8, indicate the presence of full measurement invariance, suggesting minimal differences in the composites between the two samples and validating the feasibility of conducting MGA in this context despite the disparity in group sizes. This methodological rigor ensures that differences in path coefficients between male and female respondents are attributed to the moderating variable of gender rather than disparities in the measurement models of each group.

The results of the MICOM technique, presented in Table 8, indicate the presence of full measurement invariance. Following the guidelines provided by Henseler et al. (2016), it was observed that the study model, including the composites, items, and estimating procedure, exhibited consistency in the initial stage for both groups (male and female). The results of the MICOM procedure further indicated the completion of the second stage, as evidenced by the 95% permutation-based confidence interval (based on 500 permutations, as recommended by Hair et al., 2019), which showed that the correlation of the composites in both samples was not significantly lower than one (Table 8). This suggests minimal differences in the composites between the two samples. Since

the c values in the original data fell within the confidence interval, the null hypothesis could not be rejected. The obtained p-value was significantly more significant than 0.05, indicating that c was not significantly different from 1. Consequently, our study model is expected to exhibit compositional invariance.

Table 8: Summary of the MICOM results

Composite (Step 2)	***c*-value (=1)**	**95% confidence interval**	***p*-value**	**Compositional Invariance?**
Technostress	0.916	[0.812; 1.000]	0.679	Yes
Productivity	0.973	[0.995; 1.000]	0.112	Yes
Composite (Step 3a)	**Difference of the composite mean value**	**95% confidence interval**	***p*-value**	**Equal mean values?**
Technostress	0.251	[-0.254; 0.253]	0.167	Yes
Productivity	-0.159	[-0.250; 0.262]	0.141	Yes
Composite (Step 3b)	**Difference of the composite variance ratio**	**95% confidence interval**	***p*-value**	**Equal variances?**
Technostress	0.022	[-0.283; 0.357]	0.457	Yes
Technostress	0.019	[-0.179; 0.246]	0.173	Yes

Furthermore, Stage 3 of the research model, which examines potential differences in variances and mean values among groups in the composites, was successfully conducted. This analysis aimed to test the null hypothesis that there are no significant differences in the mean values and variances of the composites between the two groups. As presented in Table 8 (Stages 3a and 3b), the results do not provide evidence to reject the null hypothesis, indicating no significant differences in the mean values and variances of the composites between male and female respondents. The logarithm of the variance ratio and the difference in mean values of the composites, as shown in Table 8, both fell within the 95% confidence interval. This supports the conclusion of equal means and variances for the composites across the two groups/samples. These findings suggest that the measurement is robust, demonstrating the feasibility of conducting multigroup analysis (MGA) on this model's latent variables, as Hair et al. (2018) described. A multigroup analysis (MGA) was performed to compare males and females, and the results are presented in Table 9.

Table 9: Multigroup results on gender

Relationship	**Path coeff. (male)**	**Path coeff. (female)**	**Diff. (male vs. female)**	***t*-parametric**	**Henseler *p*-value**
Technostress -> Productivity	-0.696	-0.472	0.224	2.654	0.008

The results indicate significant differences between the two groups regarding path coefficients. Notably, a significant difference was observed between technostress and productivity, with a p-value of 0.008 based on Henseler's criterion. These findings support hypothesis H2, suggesting that gender significantly influences the relationship between technostress and productivity.

6. Results Discussions

The findings of this empirical study, which investigated the impact of technostress on productivity while considering gender as a moderating variable, align with the Job Demands-Resources (JD-R) model proposed by Bakker & Demerouti (2007). The JD-R model suggests that job demands and resources directly and indirectly affect employee well-being and performance. In this study, the negative influence of technostress on productivity among service providers in the education sector is consistent with previous research, such as the studies conducted by Johnson & Williams (2020). The dimensions of technostress, including techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, were found to impact productivity negatively. These findings support the idea that increased reliance on technology in the workplace

can lead to higher stress levels, which, in turn, negatively affects productivity, as Nisafani et al. (2020) suggested. By considering the moderating role of gender in the relationship between technostress and productivity, this study contributes to the existing body of knowledge in this area. The JD-R model acknowledges the importance of individual differences and factors that can influence the impact of job demands on employee outcomes. The study's findings highlight that gender-specific factors play a significant role in shaping how technostress affects productivity. This aligns with the JD-R model's emphasis on considering the role of personal resources and individual characteristics in the relationship between job demands and outcomes.

Moreover, our study contributes to the literature by highlighting the moderating role of gender in the relationship between technostress and productivity. The findings demonstrate that the impact of technostress on productivity varies between genders, with one gender experiencing a more pronounced negative impact than the other. This aligns with previous studies that have reported gender differences in the experience and effects of technostress (Bapna et al., 2017; Huang et al., 2019). For instance, research has shown that women may face unique challenges related to technology use and adaptation, which can influence their technostress levels and subsequent productivity outcomes (Bhatia & Singh, 2018). Another study by Huang et al. (2019) explored the influence of technostress on job satisfaction and work performance, considering gender differences. Their findings indicated that women experience higher levels of technostress, which subsequently affects their job satisfaction and work performance more negatively compared to men. This supports the notion that gender can moderate the relationship between technostress and productivity outcomes.

Furthermore, Bhatia and Singh (2018) investigated gender differences among information technology professionals in technostress. They found that women faced unique challenges related to technology use and adaptation, leading to higher levels of technostress. This aligns with our study's findings, suggesting that gender-specific factors should be considered when addressing technostress and its impact on productivity. Our study expands on the existing literature by providing empirical evidence of the relationship between technostress, productivity, and gender in the education sector. The findings underscore the importance of considering gender-specific factors when addressing technostress and implementing strategies to enhance productivity. Organizations and policymakers can utilize these insights to develop targeted interventions, training programs, and support systems that cater to the unique needs and challenges of service providers of different genders. By doing so, they can effectively alleviate technostress, improve productivity, and create a conducive work environment in the education sector.

By integrating the moderating role of gender, this research contributes significantly to the existing knowledge base, supporting the JD-R model's emphasis on personal resources and individual characteristics in managing job demands. Our findings reaffirm the detrimental effects of technostress on productivity and enhance understanding of how these effects are differentiated by gender.

7. Practical Implications and Limitations

The findings of this empirical study have practical implications for policymakers in the education sector in Jordan. The results highlight the negative impact of technostress on service providers' productivity, indicating the need for interventions and policies to address this issue. Firstly, policymakers should prioritize identifying and understanding technostress among service providers in the education sector. This could be achieved through comprehensive surveys or assessments that assess the prevalence and specific sources of technostress. By gaining insights into service providers' specific challenges, policymakers can develop targeted strategies to alleviate technostress and promote productivity.

Additionally, policies should focus on providing adequate training and support for service providers to cope with technostress effectively. This could include training programs that enhance digital literacy skills, provide strategies for managing technology-related challenges, and promote a healthy work-life balance in the context of remote working and education. By equipping service providers with the necessary skills and resources, policymakers can empower them to navigate technostress and enhance their productivity effectively.

Moreover, gender-specific policies and interventions are essential to address the moderating role of gender in the relationship between technostress and productivity. Recognizing that the impact of technostress varies between genders, policymakers should implement gender-sensitive approaches that consider the unique challenges and needs of male and female service providers. For male colleagues, the focus should be on enhancing technological self-efficacy and resilience training. This could involve workshops or programs designed to boost confidence in using new technologies and strategies for managing stress related to technological changes. Conversely, for female colleagues, the emphasis should be on creating supportive networks and

facilitating work-life balance. Initiatives like mentorship programs and flexible work schedules can help navigate technostress and manage work and personal life more effectively.

These interventions should be complemented by organizational policies that recognize the unique challenges each gender faces about technostress. Regular assessments of technostress levels and providing access to counseling or mental health support are key components of a comprehensive approach. Furthermore, collaboration between policymakers, educational institutions, and technology providers is crucial. Policymakers should partner with educational institutions to develop guidelines and best practices for technology integration in the education sector. These guidelines should minimize technostress among service providers and promote effective utilization of technology to enhance productivity. Technology providers can also contribute by designing user-friendly and intuitive technologies that minimize technostress and optimize productivity. Consistent with the findings of our study, Wang & Zhao (2023) underscore the need for targeted strategies to manage technostress among educators in remote working environments. This study recommends implementing mindfulness-based stress reduction programs and regular digital detox sessions, strategies supported by Weinert et al. (2020) to mitigate the impact of technostress on productivity.

Furthermore, Yang & Du (2024) highlight the importance of organizational support and flexible work policies in managing technostress. This reinforces our suggestion to develop institutional frameworks that prioritize mental health and well-being for educators. Additionally, government reports on workplace well-being, such as those by the Ministry of Higher Education, advocate for integrating mental health services and stress management programs in educational institutions. These initiatives align with our study's recommendations and provide a comprehensive approach to addressing the challenges posed by technostress.

Overall, policymakers in the education sector in Jordan should consider the findings of this study to inform the development of policies and interventions that address technostress and enhance productivity among service providers. Policymakers can create a conducive work environment that maximizes productivity and well-being in the education sector by prioritizing technostress reduction, providing training and support, implementing gender-sensitive approaches, and fostering collaboration. However, it is important to acknowledge the limitations of this study. The research was conducted in the specific context of the education sector in Jordan, and the findings need to be more generalizable to other industries or cultural contexts. Future studies could consider examining the moderating role of gender in different sectors and diverse geographic regions to enhance the external validity of the findings. Additionally, qualitative research methods could provide deeper insights into how gender influences the relationship between technostress and productivity.

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The Preferred Use of Google Classroom Features for Online Learning in Indonesian EFL Classes

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Abstract: Google Classroom has been frequently used as an e-learning platform to substitute for Learning Management System (LMS), and the use of its features (Classwork, Stream, People, etc.) varies among teachers with different goals, focuses, and familiarity. However, research has not addressed how the selection of Google Classroom features affects students learning experience. Therefore, this study was aimed at finding out how Google Classroom features should be used to better facilitate online learning among students in English as a foreign language (EFL) classes. The data for this research was collected from ten leading schools in Indonesia, and 373 students participated in this study. Two questionnaires were used and delivered online, i.e. a Google Classroom Use questionnaire with Google Classroom features, consisting of 23 items, and a Technology Acceptance Model (TAM) questionnaire specified for EFL, consisting of 21 items with four constructs, i.e. usefulness, ease of use, intention, and actual system of use. The data were analyzed using multiple linear regression model to determine the effect of each Google Classroom feature on students' perception of TAM indicators. The hypotheses were rejected at the significance level of 0.05. The research results show that there is a correlation between both variables. The results also show that Classwork and Stream features were significant predictors for almost all TAM indicators. In this case, Classwork feature covers learning activities, and Stream feature includes interaction or communication facilities. Based on these results, it can be suggested that e-learning needs to facilitate students learning activities (e.g., quizzes, assignments, materials, and schedules) and student interaction/communication (e.g., announcements, notices, discussions, and shared posts). The results of this study contribute to educators and e-learning developers to consider maximizing the use and design of learning activity and interaction features due to their significance in online learning.

Keywords: Classwork, Google Classroom, Online class, People, Stream

1. Introduction

With the recent development of technology in education, teachers can take advantage of several platforms as learning tools, such as Google Classroom, Moodle, Schoology, Edmodo (Saidi et al., 2021), Skillshare, Udemy, WeVideo, Flipgrid, and Seesaw (Mishra, Gupta and Shree, 2020). The research conducted by Mulyani et al. (2021) shows that there are four learning platforms that students most prefer in Aceh, namely, WhatsApp, Opensimka, Google Classroom, and Google Meet. Albashtawi and Al-Bataineh (2020) found that many students consider Google Classroom useful, and they agree that it serves its purpose as an online learning tool. Google Classroom has adequate features which assist teachers in facilitating learning activities (Apriyanti et al., 2019, Susanti, Junining and Hamamah, 2021). With this e-learning platform, students can still learn outside the classroom as long as they have an internet connection. Research also shows that students performed better when their teachers used a learning management system (LMS), such as Google Classroom, Moodle, Blackboard Education, or Canvas, compared to when they learned using a computer-based application, such as Rosetta Stone (Oguguo et al., 2021).

This research only focuses on online learning using Google Classroom because it is one of the most popular platforms used by teachers and students (Saidi et al., 2021). In addition, when Google Classroom is used effectively in the learning process, it can make students learn more productively (Tuffahati and Nugraha, 2021). There are three main features of Google Classroom, namely Stream, Classwork, and People. Stream is the feature to make announcements, post discussions, view assignments, and preview material from topics given by the teacher. In the Classwork feature, teachers can create test or quiz questions, upload materials, provide assessments, and upload media and documents prepared in Microsoft Word, Excel, and PowerPoint. In the People feature, teachers can invite students to the Google Classroom through access codes. With these three main features, teachers can manage student assignments more easily and provide assessment results

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effectively. However, many teachers do not take full advantage of all these features available in Google Classroom. Previous surveys show that teachers predominantly only used Google Classroom to upload the material and give assignment in Stream feature (Ritonga et al., 2023, Ugla and Abdullah, 2022). These facilities are significant for learning process, but Google Classroom has many other features which teachers rarely used, such as discussions and quizzes (Nuryatin et al., 2023, Othman et al., 2022). Discussion has been claimed to be an essential learning activity because it facilitates engagement (Gameil and Al-Abdullatif, 2023). This feature also enables student-centered learning. The absence of discussion in online classes is a shortcoming of this learning mode. In addition, quizzes under the classwork features are also rarely used based on a previous study (Alom et al., 2023). This feature can facilitate gamification, which is a learning approach advocated for English as a foreign language (EFL) learning, and its effectiveness has been evident from many previous studies (Khaldi, Bouzidi and Nader, 2023). The fact that teachers do not utilize this feature is problematic and they have lost some of the significant opportunities available to them by using Google Classroom. In addition, many teachers used the quiz feature in Google Classroom only as a testing tool instead of as an entire teaching platform (Haryono and Hamzah, 2023). Therefore, teachers need to be aware what features are beneficial for students' learning, so that they can better prepare for class when using this learning management system.

In short, the use of Google Classroom is generally beneficial for teachers and students in supporting the teaching and learning process (Hamid, 2020). Several uses of Google Classroom in the learning process have been studied, such as the advantages and disadvantages of Google Classroom (Susanti, Junining and Hamamah, 2021), the effectiveness of using Google Classroom (Albashtawi and Al-Bataineh, 2020), the perception of teachers and students in using Google Classroom (Hamid, 2020). However, these previous studies have not addressed which features are considered useful in learning process of an online EFL class. Therefore, the objectives of this research are to determine correlation between Google Classroom (GC) feature use as an independent variable and student perception of online learning as a dependent variable, and to find out how much the independent variable predicts the dependent variable. Specifically, the research questions to be addressed are as follows:

RQ1: Do relationships exist between the frequency of GC feature use and student perception of online learning?

RQ2: To what extent does the frequency of GC feature use predict students' perception of online learning?

2. Literature Review

2.1 Google Classroom and its Features

Google Classroom is the most popular learning management system among teachers working in an institution which does not host any advanced LMSs like Moodle or Blackboard (Khairani, Daud and Mahdum, 2020). The popularity of Google Classroom among educators is motivated by the fact that it is easy to use, uses little computer storage memory, and facilitates teachers and students in achieving learning goals (Octaberlina and Muslimin, 2020). Unlike other advanced LMSs such as Moodle (Goyal, Khaliq and Vaney, 2023), Google Classroom features are easy to navigate. The use of Google Classroom for the learning process is also user-friendly for teachers and students (Ugla and Abdullah, 2022). In 2019, it was used as an LMS by over 40 million teachers and students around the world in elementary schools, middle schools, and high schools for blended classes, i.e. a combination of online and face-to-face classes (Lee and Cha, 2021). Google Classroom is integrated with Google Drive for storing and sharing files for assignments, Google Docs for word processing, Google Sheets for spreadsheets, Google Slides for presentations, Google email for communication, and Google Calendar for setting deadlines (Nancy, Parimala and Livingston, 2020). Therefore, teachers and students who are familiar with Google Docs can use Google Classroom easily (Ugla and Abdullah, 2022). Other LMSs use html-enabled textbox, and many teachers and students might not be familiar with this type of input system (Asamoah and Oheneba-Sakyi, 2023).

Google Classroom can help facilitate the teaching and learning process because it offers many features which can be used in online learning (Shak et al., 2022). These features are a simplified version of the major features offered in other advanced LMSs such as Moodle, Blackboard, and Canvas (Gamage, Ayres and Behrend, 2022, Kasim and Khalid, 2016). Many types of learning activities can be created using Google Classroom and those activities are covered under three main features, i.e. Stream, Classwork, and People (Cristiano and Triana, 2019). All of these features are available for all teachers with a Google Classroom account; therefore teachers can deliver learning material and other learning activities, and students can submit their works (Abuzant et al., 2021, Apriyanti et al., 2019). Most of the LMS feature requirements suggested by Basal (2016) were offered by Google Classroom.

2.1.1 Stream

An LMS is expected to manage online activities for what is normally done in a traditional class. Google Classroom has supported most of these activities. Stream is a Google Classroom facility for announcements, discussions, assignments, materials (Zhang, 2021). Students can post comments in class, and announcements are displayed in the stream to be read by teachers and other students. By providing a single point of access to discussion forums and assigned assignments, Google Classroom can simplify communication and workflow for students (Iftakhar, 2016). Communication between teacher and students, and interactions among students create social engagements in an online classroom (Xu, Chen and Chen, 2020). According to Wang et al. (2022), social engagement in an online learning can potentially improve learning achievement. In addition, students can see documents, links, and websites that teachers share as subject materials (Phoenix, 2020). This feature can help teachers and students communicate in sharing materials and assignments (Widiyatmoko, 2021). The teacher can also include a place for recording student attendance in this feature. These facilities make instruction through online learning delivery better than traditional in-person instruction (Gao-Chung et al., 2021). This Stream feature in Google Classroom is the home page feature in Google Classroom, where other activity updates are recorded. Other more advanced LMSs such as Moodle and Blackboard also offers this features, but they are more personalized and more complete. For example, these LMSs are equipped with access restriction in activity lists, activity tracking in material, and html formatting (Dvorak, 2011). However, the simplicity offered by Google Classroom helps teachers use this feature without a need for specific training (Nuryatin et al., 2023).

2.1.2 Classwork

With this feature, teachers can create tests or quizzes, upload materials, and provide assessments for student assignments (Tuffahati and Nugraha, 2021). Unlike the Stream feature, where assignment and materials can be delivered in the form of announcements, the Classwork feature has specific facilities for each learning activity (Zhang, 2021). Classwork is integrated with Google Calendar for scheduling and a Google Drive folder to store all materials, and files can be uploaded from computer drives or smartphones (Shana et al., 2021). Teachers can upload assignments in Microsoft Word and PowerPoint formats, as well as photo, audio, and video files, and students can directly complete the assignments in the provided sections, or students can also upload their completed assignments as documents, photos, or videos (Widiyatmoko, 2021).

This feature is central for the teaching and learning processes because it includes assignments, quiz, questions, materials, topics, reuse posts, and grading (Miller, 2020). First, in the Assignment section, teachers can create tasks, and teachers can also use this facility to assign homework (Zhang, 2021). This is significant for learning because students can complete their work independently. According to Zheng et al. (2023), this learning habit improves students' ability to self-regulate their learning. Second, the Quiz section is used to create quiz-type questions for the question-and-answer process. Quizzes can be distributed using Google Forms so that it can be graded automatically when students submit them in Google Classroom (Susanti, Junining and Hamamah, 2021). Not only will teachers save grading time, but their students will also receive instant feedback on their work. There have been many studies which found the advantages of immediate feedback, among which are learning engagement (Sancho-Vinuesa, Escudero-Viladoms and Masià, 2013) and learning achievement (Razzaq, Ostrow and Heffernan, 2020). Third, Questions are the same as assignments, but in this section teachers can choose between using short answer or multiple-choice questions. Therefore, teachers can use this section for gamification, which has been proven to positively affect student perception and achievement based on previous studies (e.g. Alajaji and Alshwiah, 2021, Khan, Ahmad and Malik, 2017, Sotos-Martínez et al., 2022). Teachers can also provide essay exercises in Question section. Fourth, Materials is where teachers share the teaching materials to students (Zhang, 2021). In this section, teachers can share any files and videos, or create text documents, slides, spreadsheets, or Google Forms. In addition, teachers can also share links for other external sources. Therefore, it is effective to improve student autonomy through this LMS by utilizing the Material section (Moca, 2022). In language learning, learner autonomy is claimed as a key to learning success among EFL students (Sukerti and Yuliantini, 2018). Fifth, in Topics, teachers can create titles or topics that distinguish one material from another. Sixth, Reuse Posts, is helpful when teachers want to use specific posts multiple times (Miller, 2020). Finally, the Grading is tool which teachers can use to assess assignments, and teachers can give personalized feedback for individual students. There is also the option to provide feedback on the Assessment instrument (Widiyatmoko, 2021). Moreover, there is a Helper feature, namely originality report, in Classwork feature, which teachers can use to assess the quality of student assignments by viewing the sections of assignments that students have previously posted (Falabiba, 2020). Most of facilities in major LMSs are offered by Google Classroom Classwork features. However, Workshop activity module, such as in Moodle, is missing in

Google Classroom. This module enables peer assessment, which can foster student engagement (Elfiondri, Mustafa and Yusuf, 2022).

2.1.3 People

With this feature, teachers can check the number of participants, which includes educators and other students, and teachers can also add participating members by registering their email accounts (Zhang, 2021). The teacher can invite students with an access code, which teachers can modify or disable, which will not affect members who are already enrolled (Miller, 2020). There are two roles to choose in this feature, i.e. students and teachers, where students in one class can have a role as teachers in another class. Students can submit their work online for their teacher to grade before the deadline, and teachers can see each student's progress, and they can return assignment to the students with necessary comments, so students can revise their assignments (Sukmawati and Nensia, 2019). This feature offers only minimal capability for user management, and only two roles are possible (Zhang, 2021). Other LMSs, such as Moodle, can assign multiple roles, such as non-editing teachers, which can be used by teacher assistants, and observer role for auditing students. In addition, teachers cannot customize access for each role (Dvorak, 2011). In Moodle, for example, certain activities can only be accessed by specific students. For example, students who do not reach passing grade in a quiz may have an option to read extra materials which other students cannot. This feature is significant for personalized instructions, which has been proven helpful in multi-level instruction (Tan et al., 2008).

2.1.4 Additional features

In addition to the main features of Google Classroom, there are some other features which facilitate better experience for both teachers and students. Some of those features are not related to the teaching and learning process, but Google provides these features to ensure that teachers and students can confidently use Google Classroom for their purposes (Susanti, Junining and Hamamah, 2021). These features include course archives, mobile capability, and privacy. First, “Archive a class”: when a class is archived, it is transferred to the Class Archive area from the homepage. Teachers and students can see archived classes, but they will not be able to edit them until they are restored (Zhang, 2021). However, teachers cannot export past courses which can be shared with other colleagues, as teachers can do in other LMSs such as Moodle, Canvas, and Blackboard (Dvorak, 2011). Course importing and exporting is significant for teacher collaboration, which has been advocated for in online learning (Carpenter, Kerkhoff and Wang, 2022). Second, mobile-support access makes students able to use Google Classroom flexibly. The apps can take photos and use them for tasks, and files can also be transferred from other apps. Google Classroom may be viewed using Google Chrome or other web browsers on any computer or mobile devices (Zhang, 2021). All files uploaded by teachers and students are saved in the Google Drive Class folder, which can be accessed anywhere when necessary (Brock, 2020). However, many studies found that one of the challenges of online learning is internet connection. Google Classroom does not have any offline access feature. Other LMSs can be installed in a smartphone and all course contents can be downloaded when connected to the internet so that students can continue working on the course without any internet connection. Their assignments and other learning activities can be automatically synched when the phones are connected to the internet (Nash and Rice, 2022).

2.2 Google Classroom in Language Teaching

Technology integration in language teaching has been considered necessary to make the teaching and learning process more effective (Syakur, Sugirin and Widiarni, 2020). Google has supported this online learning initiative through its Google Apps for Education (GAFE), one of which is Google Classroom. Google Classroom can be useful for students, teachers, and online education because of its features, its accessibility from any device, and its no-cost access for qualifying educational institutions (Syakur, Sugirin and Widiarni, 2020). The Google Classroom feature that is most often used in the Stream feature is sharing announcements; on the Class Assignment feature to assess and submit assignments (Joshi and Kariya, 2019). The part that is rarely used is the People feature because it is sufficient to enter a class member only once. Google Classroom has been used by teachers for a variety of purposes, including increasing student participation (Beaumont, 2018). It is a simple LMS intended to substitute for face-to-face interaction, so that teachers can present a lesson without any complex processes (Sartika, 2021).

In English language teaching, the use of Google Classroom is very effective in improving all language skills individually or in an integrated mode of teaching (Albashtawi and Al-Bataineh, 2020). In addition, Google Classroom can be integrated into various teaching strategies in an English language class (Nursyahrina et al., 2021). For example, teachers can facilitate online discussions among students and develop group projects.

Students can also work together on Google Docs that have been shared by teachers. Google Classroom can be used to assign lessons to entire classes, individual students, or groups of students. Therefore, Google Classroom has been used in facilitating collaborative learning in language classes (Nuryatin et al., 2023).

Google Classroom has been shown to be effective as a tool for students learning English in several studies. A study has investigated technology-based Google Classroom in a business English writing class (Apriyanti et al., 2019). According to this study, the use of Google Classroom brought positive results to the teaching and learning process of business English writing class. Each student received their writing corrections from the feedback given by the teacher, such as misspellings, wrong word choices, grammar, and structures that need to be corrected. Another study found that Task-based Language Teaching (TBLT) can be facilitated with Google Classroom, and it has been found that it positively affect student motivation (Faridi, Saleh and Fitriati, 2021). Lin (2021) found that students could improve their writing skills, both in knowledge and writing quality. In an integrated listening and speaking class, a study found that Google Classroom can help students improve their speaking skills because students could understand the material better and they got exposure to authentic language because it was presented by teaching experts in videos (Isda et al., 2021). Since students have access to the video embedded on Google Classroom, they could watch the videos multiple times for language exposure. A study revealed that exposure to native speaker oral language improve both listening and speaking skills (Gámez and Levine, 2013, Musa and Fojkar, 2019). Furthermore, in teaching reading comprehension, Jiemsak (2021) experimented with Google Classroom and found that students could improve their reading comprehension due to better learning management, well-organized material delivery by teachers and peer collaboration. Another study also found significant improvement in reading comprehension in experimental group with Google Classroom, compared to the control group (Gao-Chung et al., 2021). Finally, the effectiveness of Google Classroom integration in language learning can be credited to improvements in language features such as grammar and vocabulary. A study found that Google Classroom can help teachers facilitate learners to improve their grammar knowledge through online activities, practices, and formative tests (Haggag, 2019).

Finally, much research has looked at the affective aspects related to Google Classroom. For example, research has been found that students showed positive attitudes towards learning writing in English class delivered using Google Classroom (Sartika, 2021). They reported that Google Classroom could help them complete activities efficiently. They could also spend more time learning writing when the teacher delivered the material using Google Classroom. Ekahitanond (2022) also found that students learning English with Google Classroom created a positive learning environment because it is user friendly, and its features can accommodate all students' needs. Google Classroom has also been found to help students learn independently, and students who are introverted in in-person classes have been found to express themselves and participate more frequently in discussions (Ugla and Abdullah, 2022).

2.3 The use of Google Classroom by EFL Learners

Like learning other languages, English language learning benefit most from language exposure for English language acquisition. Therefore, to obtain maximum exposure, students need to be autonomous learners (Ali et al., 2024). The topic of learning autonomy has been extensively researched in the context of English language learning. Research also found that students are aware of the significance of autonomous learning (Tareen, Zhang and Haand, 2024). In addition, they are ready to take responsibility of their own learning outside the classroom (Oussou, Kerouad and Hdii, 2024). The major findings of research focusing on learning autonomy in language learning show that the factors of learning autonomy are resources availability, self-learning activities, and interaction. First, learning autonomy requires that students have access to resources outside their formal classrooms. Research has found that technology plays a significant role in developing students' autonomy in learning English (Bin-Hady and Ali, 2024). Without the support of technology, students consider that teachers are more responsible of their learning (Win and Kálmán, 2023). Therefore, the use of online learning management system such as Google Classroom facilitates students to learn autonomously. Furthermore, another factor is self-access learning activity, suggesting that students need to be able to manage their own learning activities without any time constraints. A study by Thi Mai (2023) found that students have a positive autonomous learning experience when the learning activities can be completed at students' convenience. Finally, To succeed in learning English autonomously, students need to interact with peers. Treesattayanmunee and Baharudin (2024) found that students who interacted better with peers were more autonomous. Another study found that students who have access to online interaction platform develop better learning autonomy and achieve better learning outcomes (Janfeshan, Sharhan and Janfeshan, 2023). This interaction is not always possible outside the classroom in traditional learning setting. Using Google Classroom, however, students can interact and collaborate online to complete learning activities.

2.4 The Present Study

Based on the literature review, there have been much research on the use of Google Classroom in EFL classrooms. Those studies have found that Google Classroom can help teachers improve their students' language skills (e.g., Albashtawi and Al-Bataineh, 2020, Jiemsak, 2021, Lin, 2021). The use of Google Classroom to facilitate teaching and learning process can also improve students' motivation (Faridi, Saleh and Fitriati, 2021). Other studies have also investigated students' perception regarding the use of Google Classroom in their English classes (e.g., Ekahitanond, 2022, Sartika, 2021). It has also been concluded that Google Classroom could be implemented successfully, as it is simple to use and students had positive attitudes toward learning English with it (Joshi and Kariya, 2019, Shana et al., 2021). However, our present study offers a method of how Google Classroom can be used more effectively by determining what features play more significant roles particularly in EFL classes. Although there are many studies looking at the effectiveness of Google Classroom and students' experience in using this LMS, research to determine how it should be used more effectively to create even better experience is lacking.

3. Method

This research was a quantitative research study, which used inferential statistical analysis to make conclusions. The data were all ordinal categorical data, and thus non-parametric statistic tests were utilized. However, descriptive statistic was also used to show the shape of the data.

3.1 Participants

The data for this study were collected from ten leading senior high schools in Indonesia. This study was conducted in November 2021, during which students in Indonesia had just experienced online learning due to the Covid-19 pandemic. The number of participants was 373, consisting of 253 females and 120 males (see Table 1). They were mostly 16 and 17 years old. The schools in Table 1 were selected because the majority of the students in these schools lived in internet coverage areas, had adequate internet-accessing devices for online learning, and could afford internet data. Therefore, the questionnaire items should make more sense for these students than students in other schools. In addition, the selection of schools by considering the demographical similarities of the students was made to eliminate possible intervening variables.

Table 1: Distribution of respondents' schools

No	Names of Schools	Females	Males	Total
1	SMKN 1 Tambun Selatan	63	20	83
2	SMAN 10 Fajar Harapan	49	24	73
3	SMAN 2 Banda Aceh	28	15	43
4	SMAN 11 Banda Aceh	21	16	37
5	SMA Unggul Tapaktuan	24	12	36
6	SMAN 1 Banda Aceh	23	9	32
7	SMAN 1 Takengon	19	9	28
8	SMAN 1 Meulaboh	7	3	10
9	SMAN 1 Panyambungan Selatan	5	1	6
10	Other schools	14	11	25
	Total	253	120	373

3.2 Instruments

This research used a set of questionnaires for data collection. The first questionnaire was aimed at obtaining information about the use of features in Google Classroom. This questionnaire was designed based on four constructs proposed by Cristiano and Triana (2019), namely, Classwork (7 items), Stream (9 items), People (2 items), and another construct was based on Susanti, Junining and Hamamah (2021), i.e. additional features with five items. A five-level Likert scale was used for this questionnaire (*1 = never to 5 = always*). The second questionnaire was used to find out the students' perception of having an online class with Google Classroom. The writer used the Technology Acceptance Model (TAM) for this questionnaire, adapted from Davis (1989) by Al-Maroof and Al-Emran (2018), consisting of four constructs, i.e. perceived usefulness (7 items), perceived ease of use (6 items), behavioral intention (4 items), and actual system of use (4 items), also presented in a five-level

Likert scale (*1 = strongly disagree to 5 = strongly agree*). Finally, the questionnaire was presented with some questions to collect biographical information, including age, gender, perceived English language skills, and experience with Google Classroom. Due to limitation of the research scope, this study did not record other possible moderating variables such as student learning style preferences, English language levels, levels of learning autonomy, internet access level, or curriculum design.

3.3 Data Collection

To collect the data for this study, the writer sent an online questionnaire in Google Forms to the target participants through their teachers to be distributed to their students. The purpose and instruction were included at the beginning of the questionnaire. It was also stated that their teachers would not be given access to their responses, and they were not asked to provide their identity. The questionnaire administration was completed in one week. The writer sent a reminder to the students on the third and fifth day after the questionnaire was sent.

3.4 Data Analysis

The data analyses for this research were divided into several analysis sections. The first analysis deals with scale validation. Since the Google Classroom use questionnaire was designed by the researchers, it needs to be systematically validated. Confirmatory Factor Analysis (CFA) was used to check whether the questionnaire items fit the construct based on the factor loading. The item with factor loading of less than 0.30 was removed from the scale. Cronbach's alpha was calculated for each scale to obtain internal consistency of the scale. In the second analysis, multiple linear regression tests were performed for each TAM dimensions as the response variable and Google Classroom feature as predictor variables. This type of statistical analysis is normally used for numerical data, but it is applicable in this research because the data were analyzed in averages. In addition, this analysis is recommended by Hair, Page and Brunsveld (2020), and it is a common practice in social research studies. The significance level used in this research was 0.05 both for adjusted R^2 and coefficient estimates. Finally, multicollinearity was detected using Variance Inflation Factor (VIF), where the VIF value of 5 or lower is considered to post no risk of multicollinearity (James et al., 2021).

4. Results

This section presents results from both descriptive and inferential statistical analysis. In addition to the results of study to answer research questions, this section also presents the results of factor analysis.

4.1 Factor Analysis Results

The factor loadings and correlation between one construct and another for each scale is presented in Figure 1. One item which belongs to the additional feature has been removed because the factor loading is less than 0.30.

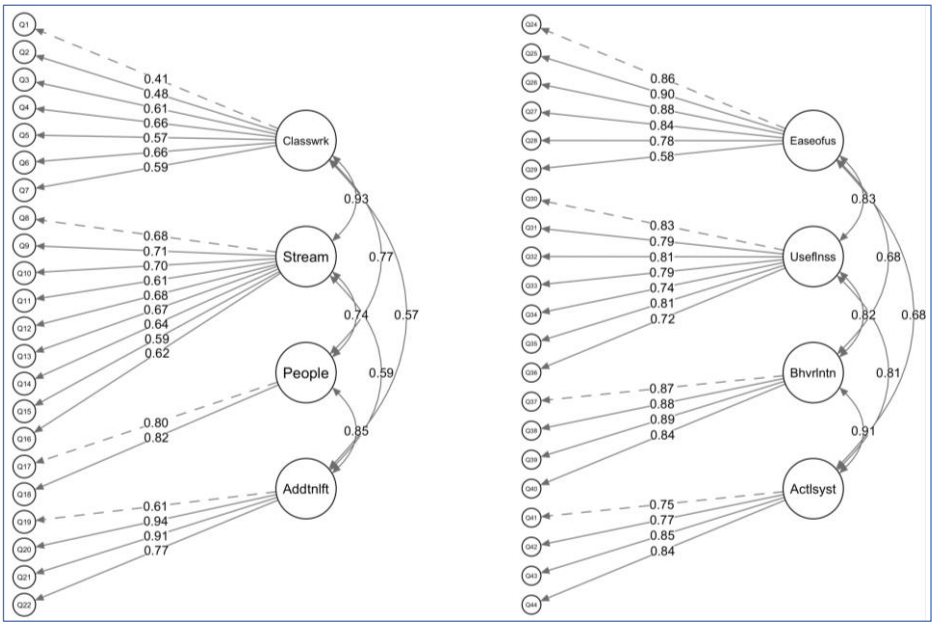

Figure 1: Results of CFA for Google Classroom use (left) and TAM (right)

Figure 1 shows that the factor loadings for each item in the scale of Google Classroom use range between 0.41 and 0.94. Due to a removal of an item in the People feature because of low factor loading, only two items are left. All factors are correlated to one another, starting from moderate to strong correlations. In addition, the figure also shows that factor loadings for TAM, in which all items fit better to the factors, and each factor correlates stronger to others. This is expected because the scale of TAM is a well-established scale which has been validated in many previous studies. The internal consistency of the Google Classroom use was 0.93 and 0.96 for TAM questionnaire, calculated using Cronbach's alpha. The internal consistency, correlation among factors, and factor loadings of TAM questionnaire in this study were not lower than the original version reported by Davis (1989) or the version adapted by Al-Maroof and Al-Emran (2018).

4.2 Descriptive Statistics of Students' Responses

Descriptive statistics of each construct in both scales are presented in Table 2. The table is based on five-number summary, including minimum and maximum values, first and third quartiles, median, mean, and standard deviation.

Table 2: Summary of students' response to the scales

Constructs	Min	Q1	Median	Q3	Max	Mean	sd
Classwork	1.00	2.86	3.43	3.86	5.00	3.36	0.73
Stream	1.00	2.89	3.44	4.00	5.00	3.43	0.81
People	1.00	3.50	4.00	5.00	5.00	3.99	0.97
Additional Features	1.00	3.75	4.25	4.75	5.00	4.11	0.85
Perceived Ease of Use	1.00	3.67	4.00	4.33	5.00	3.91	0.72
Perceived Usefulness	1.00	3.29	4.00	4.29	5.00	3.78	0.75
Behavioral Intention	1.00	3.00	4.00	4.25	5.00	3.68	0.93
Actual System of Use	1.00	3.00	3.75	4.00	5.00	3.62	0.86

Table 2 illustrates that, for the Google Classroom use questionnaire, People and Additional features are more frequently used than the other features. For the TAM questionnaire, the response for each construct is uniform, with a more positive perception for ease of use based on its mean. For both scales, the standard deviations are similar for all constructs, indicating the data quality is uniform across all constructs of both scales.

4.3 Inferential Statistical Analyses

This research uses a multiple linear regression model to find out which features of Google Classroom predicted each factor in the TAM questionnaire in positive direction (see Table 3). A feature was considered significant for learning process if it predicts students' perceptions measured using TAM questionnaire.

Table 3: Results of multiple linear regression

Coefficients	Estimate	Std. error	t-value	p-value	
Ease of use [*RSE = 0.599, adjusted R^2 = 0.310, F-statistic = 42.93, p-value = 0.000*]					
(Intercept)	1.717	0.171	10.060	0.000	***
Classwork	0.291	0.068	4.290	0.000	***
Stream	0.051	0.064	0.799	0.425	
People	0.018	0.052	0.349	0.728	
Others	0.234	0.057	4.100	0.000	***
Usefulness [*RSE = 0.610, adjusted R^2 = 0.333, F-statistic = 47.36, p-value = 0.000*]					
(Intercept)	1.534	0.174	8.832	0.000	***
Classwork	0.142	0.069	2.056	0.040	*
Stream	0.279	0.065	4.290	0.000	***
People	0.021	0.052	0.391	0.696	
Others	0.176	0.058	3.030	0.003	**
Behavioral intention [*RSE = 0.833, adjusted R^2 = 0.193, F-statistic = 23.20, p-value = 0.000*]					

Coefficients	Estimate	Std. error	t-value	p-value	
(Intercept)	1.660	0.237	6.993	0.000	***
Classwork	0.181	0.094	1.919	0.056	.
Stream	0.341	0.089	3.832	0.000	***
People	-0.013	0.072	-0.178	0.859	
Others	0.070	0.080	0.884	0.377	
Actual System of Use [*RSE = 0.737, adjusted R^2 = 0.259, F-statistic = 33.5, p-value = 0.000*]					
(Intercept)	1.520	0.210	7.246	0.000	***
Classwork	0.217	0.083	2.603	0.010	**
Stream	0.367	0.079	4.669	0.000	***
People	-0.016	0.063	-0.256	0.798	
Others	0.042	0.070	0.605	0.546	
Note. Significance codes: 0.000 '' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1***					

Pursuant to research question 1, Table 3 shows that a significant relationship exists between frequency of all Google Classroom features use and students' perception of online learning. The proportion of variance is represented by adjusted R^2, which is a correction between the observed values of the student perception of online learning and its predicted values to show how well the model fits the data. The *p-values* of less than 0.05 indicate that the significant correlations exist between all the frequency of Google Classroom feature use and all constructs of TAM. For the second research question, Table 3 shows that all models were significant, where the 19%–33% of variations in the students' perception could be explained by the use of Google Classroom features. The table also shows that classwork predicts all dimensions of TAM except in behavioral intention. In addition, the Stream feature is also a significant predictor for TAM dimensions except for ease-of-use. Additional features were predictors only for usefulness and ease of use. To ensure that there was no issue with multicollinearity, a Variance Inflation Factor (VIF) was calculated along with correlation between variable using Spearman method due to issue of normality distribution, presented in Table 4.

Table 4: Results of multicollinearity detection using VIF

Predictor variables	Classwork	Stream	People	VIF
Classwork				2.55
Stream	0.76			2.76
People	0.56	0.57		2.60
Additional Features	0.46	0.55	0.72	2.44

Table 4 shows that the correlations between one variable and another were detected at a moderate level. In addition, a VIF of lower than 5.00 indicates that there was no risk of multicollinearity in the model.

5. Discussion

The objective of this research was to determine the Google Classroom features which were considered effective for learning process measured based on TAM indicators. The multiple linear regression analysis results show that the Classwork and Stream features are predictors of three out of four TAM indicators, while additional features are predictors of two indicators and the People feature is not a significant predictor for any indicator. The percentage of variations in TAM indicators explained by the significant predictors vary, with a higher percentage for ease of use and usefulness than actual system of use and behavioral intention. These results have offered significant information to establish what Google Classroom features should be used for effective online learning process in an EFL class.

The first significant feature, i.e. Classwork, is expected because the feature includes all core online learning activities such as assignments, tests, and access to materials. In addition, the three learning activities are the primary components of learning process in a "traditional" classroom. In online learning through Google Classroom, students found that these web-based activities facilitated better learning experiences because they can always access assignments and materials. They can also submit their assignments when they finish them without the need to travel to physical classrooms. Finally, quizzes or exercises are also delivered through the

Classwork feature, and previous studies have found that students enjoyed immediate feedback for quizzes and exercises (Cole and Todd, 2003). Various studies have confirmed that immediate feedback is more helpful for material mastery and student retention (Hattie and Timperley, 2007, Molloy and Boud, 2014, Suryati, Chen and Archer, 2013). In this feature, teachers can also put in more effort to provide personalized feedback, which is more interactive for students.

One of the most important components of learning is the interaction between students and teacher, as well as between one student and another (Demuyakor, 2020). These interactions can include discussion, instruction, announcements, and reminders. In Google Classroom, interactions can be facilitated by the Stream feature, and this research has shown that this feature is considered significant for students' learning processes. Previous research has found that students were more self-efficacious towards their learning success in a class where interaction was rich (Li and Yang, 2021). They believe that interaction is a factor of interactive classroom, and many studies have shown its effectiveness in terms of students' achievement and perception (Atuboinoma and Amadi, 2021, Hussain et al., 2011). Therefore, this feature is essential and available in all leading e-learning platforms and LMSs such as Edmodo, Moodle, Blackboard, and Canvas. Other generic social media such as Facebook and Instagram have also been used for online learning platform for blended learning because they facilitates interactions (Amin and Sundari, 2020, Bailey, Park and Abdoulai, 2017).

Furthermore, Classwork and Stream are predictors for three of four dimensions of TAM. Classwork was not a significant predictor of behavioral intentions. This result is unexpected because, based on previous research, behavioral intentions are affected more by familiarity (Lazar, Panisoara and Panisoara, 2020). Therefore, what we expect is that students who are familiar with Google Classroom features would have higher intention to use the features, as also the case with the Moodle LMS (Xu and Mahenthiran, 2016). This unexpected result is probably due to students' positive perception of this feature regardless of how often it was used in class. In fact, the data shows that more than 50 percent of the participants reported that they would want to use Google Classroom more frequently. Therefore, the correlation cannot be achieved without enough variation in the data, as confirmed by Harrell (2015). Furthermore, the Stream feature does not predict the ease of use of Google Classroom. Since the Stream feature facilitates interaction in an online classroom (Iftakhar, 2016), we had expected that this feature was a significant predictor. This unexpected result might be explained by the fact that other generic platforms that teachers used for online learning can substitute for interactions, such as WhatsApp (Amin and Sundari, 2020). Therefore, students were familiar with activities covered by Stream, which results in lack of variation when ease of use was considered a response variable. A lack of variation in the data results in low correlation, which makes this variable unable to predict the ease of use of Google Classroom, as suggested by Harrell (2015).

Another expected result of this research was that additional features of Google Classroom, which include mobile capability, Google Drive integration and assignment configuration by teachers, predicted ease of use and usefulness of Google Classroom. Being able to submit the assignment, access the materials, and complete other learning activities on a smartphone is expected to make the use of Google Classroom easy. According to Binyamin, Rutter and Smith (2017), this factor influences students' satisfaction in using an LMS. In addition, the ability to save files into a Google Drive or upload them into the Google Classroom was time-efficient, and thus this feature was considered useful. It was also easier for students to plan their work in completing an assignment because they could see the due date because teachers can set it in the additional features. However, the variation in the use of this feature does not contribute to students' intention to use Google Classroom, and it does not predict the actual use of Google Classroom.

Finally, the People feature was not significant for any TAM indicators, and this result is expected because students only needed to be enrolled once. All students must have been invited by their teachers to join the class by providing them with class link or class codes. Another activity in this feature is ability to see class members. Although this feature is significant for teachers, such as to assess each student's past activities or their progress (Evans, Zeun and Stanier, 2014) or to check their students' profile, our study has shown that students did not find it important because they had already known all their classmates.

This study has offered a significant pedagogical implication for use of Google Classrooms among EFL teachers in Indonesia and other similar contexts. Based on the results presented above, the features which more strongly predict TAM indicators are the Stream and Classwork features. Therefore, teachers need to dominantly use these features because they are core features of any LMS, as also suggested by Basal (2016), and may potentially lead to better student engagement, self-regulated learning, which Wang et al. (2022) predicted can improve students' achievement. However, based on the data summary as show in Table 2, teachers did not use these

two features as frequently as the other two less significant features. The same results can also be inferred from previous studies (e.g. Susanti, Junining and Hamamah, 2021, Ugla and Abdullah, 2022). Due to the simplicity of Google Classroom, teachers do not need training to use these features, but they need encouragement from peers and school administrators. In addition, teachers need to believe that these two features are significant in order that they are motivated to use them, as concluded by Asiri et al. (2012). In addition, teachers need pedagogical knowledge on using technology in teaching so that they can use Google Classroom features to their full capabilities (Prasetya, 2021).

This research certainly has limitations in that the questionnaire did not reach all the target participants. This research has a reasonably large population, but the sample size for this research was rather small. Although the number of respondents was more than 350, the researchers could not split the data into groups for further detail analyses due to limited sample size in each group. Also, with a larger sample size, more variations can be achieved in the data, which can make the research results more accurate. In addition, the questionnaire only relied on closed questions and ignored open questions, which may dig up more information from the student's perspective. For this reason, further researchers are advised to conduct more in-depth research with a larger sample in order to obtain information related to the use of features in Google Classroom that can facilitate the learning process, especially in English classes. In addition, the participants' characteristics need to be considered in making generalizations of the results, as suggested by Asiri et al. (2012). Our participants are from leading senior high schools in Indonesia. At the time of the survey, most of them lived in internet coverage areas, had adequate internet-accessing devices for online learning, and could afford internet data. Therefore, the results of the study are generalizable for the context of urban schools in Indonesia and elsewhere. The results of this study do not apply to students from rural schools because they have unique problems of internet connections and access to internet devices (Mustafa, Nguyen and Gao, 2024). A specific future study needs to be conducted in these areas. Finally, the absence of moderating variables, such as learning style preferences, English language levels, level of learning autonomy, or internet access levels, makes the results of the present study less theoretically and practically meaningful. Therefore, future studies need to involve potential moderating variables to draw more impactful conclusions. For example, students exposed to different curriculum to Indonesian high school curriculum, known as Curriculum 2013, might perceive the use of Google Classroom features differently. Therefore, curriculum needs to be considered in generalizing the results of the present study.

6. Conclusion

The primary objective of this study was to find out what Google Classroom features should be implemented in an EFL classroom to extend the results of previous studies which have shown the effectiveness of Google Classroom. Unlike previous studies, which address the use of Google Classroom in general, this study focuses primarily on the Google Classroom features individually. Based on the results of the study related to the first research question, relationships between the use of Google Classroom and some features of Google Classroom, i.e. Classwork and Stream, do exist. Similarly, Classwork and Stream were significant predictors of almost all Technology Acceptance Model (TAM) indicators. Regarding the second research questions, with Classwork, Stream, People, and additional features as the predictor variables for the use of Google Classroom, the adjusted R^2 ranges between 0.193 and 0.333, suggesting that between 19% and 33% of the variance in the use of Google Classroom can be predicted by how students used its features. In addition, Classwork and Stream are significant predictors in more models compared to other Google Classroom features. Therefore, it can be concluded that Classwork and Stream are the core features of Google Classroom which are recommended to be used comprehensively when Google Classroom is used as an online learning platform. Google Classwork features include quizzes, assignments, materials, and schedules, while the Stream feature is for announcements, notices, discussions, and shared posts. The research results suggest that both features be used side by side to complement one another in facilitating teaching and learning process. Therefore, although training is not required for teachers to use these features, our data suggest that school principals and administrators need to encourage teachers to use these features to their full capacity.

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Appendix 1: Questionnaire for the use of Google Classroom features

Items	Statements
Item 1	The teacher asks us to collect assignments that are typed directly in Google Classroom (not using Microsoft Word files or documents).
Item 2	The teacher asks us to collect assignments in the form of Microsoft Word or PDF or images via Google Classroom.
Item 3	The teacher shares the results of the assessment of the assignment through Google Classroom.
Item 4	The teacher shares comments on Google Classroom for the assignments we have collected.
Item 5	The teacher gives clear instructions in Google Classroom when giving assignments.
Item 6	The teacher asks us to complete a Quiz using Google Forms in Google Classroom.
Item 7	Materials, assignments, and quizzes in Google Classroom are organized in an orderly manner.
Item 8	The teacher provides a link to material from YouTube or a video streaming website in Google Classroom.
Item 9	The teacher provides a link to material from a website in Google Classroom.
Item 10	The teacher makes announcements via Google Classroom.
Item 11	The teacher checks student attendance through Google Classroom.
Item 12	The teacher provides a Google Meet or Zoom link in Google Classroom.
Item 13	The teacher provides material in the form of Microsoft Word, PowerPoint, or PDF via Google Classroom.
Item 14	The teacher asks us to discuss a topic through Google Classroom.
Item 15	The teacher greets us in Google Classroom when he/she starts the class.
Item 16	We comment on announcements posted by teachers in Google Classroom.
Item 17	The teacher provides a class code to join Google Classroom.
Item 18	I look at the list of class members via Google Classroom.
Item 19	The teacher stores course materials on Google Drive in Google Classroom.
Item 20	We submit assignments to Google Classroom via smartphone or tablet.
Item 21	We use Google Classroom via smartphone or tablet.
Item 22	The teacher gives a time limit for submitting assignments.
Item 23	After the end of a semester, we no longer have an access the class in Google Classroom. (This item was dropped)

Appendix 2: Scale of Technology Acceptance Model (TAM)

Items	Statements
Item 1	Google Classroom is easy to use.
Item 2	Google Classroom helps me access course materials.
Item 3	Google Classroom is simple and user friendly.
Item 4	The navigations in Google Classroom is easy to understand.
Item 5	Google Classroom helps me access and submit assignments.
Item 6	Google Classroom helps me avoid future academic problems.
Item 7	Google Classroom helps me be more productive.
Item 8	Google Classroom is useful in completing my assignment.
Item 9	Google Classroom improves my learning process.
Item 10	Google Classroom helps me submit assignments on time.
Item 11	Using Google Classroom can save me time.
Item 12	Using Google Classroom can improve the quality of the assignments I submit.
Item 13	Google Classroom can facilitate online learning.
Item 14	I'm interested in using Google Classroom more often these days.

Items	Statements
Item 15	I intend to increase the use of Google Classroom in the future.
Item 16	I wish my classmates were using Google Classroom.
Item 17	I wish Google Classroom was used in other subjects.
Item 18	I use Google Classroom every day.
Item 19	I often use Google Classroom.
Item 20	I always want to use Google Classroom to learn English.
Item 21	I feel very confident and comfortable using Google Classroom.

Teachers' Readiness in Online Learning: Digital Literacy-Self-Efficacy, Pedagogical Competence, Attitude, Infrastructure, and Management Support

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Abstract: Information and communication technologies (ICTs) are now used in education as a necessary tool. ICTs are used extensively in education, therefore, in order for teachers to effectively manage their classrooms, they need to be highly digitally skilled and have good attitudes. The spread of digital technology poses challenges as well as prospects, particularly for the younger generation. Online distance education provides individuals with convenient and accessible avenues for engaging in educational pursuits. The research aimed to analyze the teachers' readiness in online learning: digital literacy-self–efficacy, pedagogical competence, attitude, infrastructure, and management support in Indonesia. The research conducted was a quantitative study employing a survey design. The survey data was analyzed using Structural Equation Modelling (SEM) with AMOS. A questionnaire was used to gather the data. There were 2.788 teachers involved as participants throughout Indonesia. The results show the relationship between the five indicators in digital literacy-self-efficacy (TR-DLSE), pedagogical competence (PC), attitude readiness (AR), infrastructure readiness (IR), and management support (MS). The readiness in terms of attitude explains the construct the best compared to the other four indicators with a value of 0.996. The square of factor loading (FL) on the readiness of attitude is 0.93, indicating that 93% of teacher readiness levels in online learning are influenced by the enthusiastic attitude of the teachers in Indonesia. It can be concluded that the teachers' attitude readiness for online learning in Indonesia influences teachers' readiness. Suggestions for further research are provided.

Keywords: Attitude, Digital literacy, Management support, Pedagogical competence, Self-Efficacy, Teachers' readiness

1. Introduction

Teachers are vital stakeholders in the education system (Adegbola, F. 2019). The teachers play a crucial role in preparing and inspiring a new generation to effectively teach in contemporary classrooms (Arismunandar et al., 2022). Their active involvement can significantly enhance pre-service teachers' technology-enhanced teaching practises (Liu 2016; Ping, Schellings, and Beijaard 2018). The task of equipping prospective educators with the necessary skills to effectively incorporate technology into their instructional methods is a growing difficulty faced by teacher trainers (Tondeur et al. 2019). To train pre-service teachers, they need to help them bridge the gap between technology, pedagogy and content knowledge.

Moreover, technological developments are changing the education world through various activities (Hasyim et al. 2024). The COVID-19 pandemic has provided lessons, one of which is accelerating the use of digital technology, especially in education (Zalavra and Makri 2022). The advent of technology has caused much change in human life (Enwereji et al., 2023; Al Arif et al. 2024). It is not a new phenomenon in this era (Achim and Kassim 2015). Where educators, education staff and students become accustomed to using digital facilities to transform the data and information that needs to be accessed (Schmid, Brianza, and Petko 2021). The presence of technology shapes digital society. Digital literacy skills are the most basic and crucial in dealing with technological developments to facilitate educational activities.

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ICT competency is a crucial component of communication skills (Becuwe et al. 2017; Foulger et al. 2017). It has profoundly changed our society and this is the basis of today's knowledge society (Almerich et al. 2016); it has emerged as a focal point in the aims and learning outcomes of the Indonesian national curriculum. The utilization of computers and internet technology has become a commonplace occurrence in the daily activities of students and teachers (Suwarto et al., 2022). This is primarily due to the accessibility and affordability of the internet and social media platforms for the general population. Nevertheless, specific challenges persist in deploying Information and Communication Technology (ICT) in infrastructure and digital literacy.

The survey findings on the development of technology indicate that the percentage of internet users in Indonesia stands at 20.4%, corresponding to a total of 53,236,719 individuals out of the country's population of 260,581,100. However, it is worth noting that the ICT skills of these internet users in Indonesia are comparatively lower than the average proficiency observed in other OECD countries (OECD 2015). The acquisition and application of digital learning abilities and the adoption of digital learning methods continue to pose challenges for Indonesian students and teachers (Hafifah and Sulistyo 2020).

Meanwhile, based on a survey conducted by the Ministry of Communication and Information, the national digital literacy reading status data refers to UNESCO. This shows that the digital literacy index in Indonesia is only slightly above moderate but this is not yet reasonable. Achieving a good level of literacy requires the role of all parties, including the government and society and support from the world of education. On a smaller scale, school organizational support plays a role in accelerating the digital transformation process. The administrative support referred to in this case includes facilities, infrastructure, and a comfortable environment for educators, education staff, and students in the school environment. In the digital era like today, daily activities are used. Digital media can no longer be avoided. Therefore, high digital literacy skills are required for every teacher. With digital literacy skills, information will be obtained very quickly. Teachers with good literacy skills will influence the learning process, increasing student teacher self-efficacy and ultimately improving performance. With high literacy skills, teachers will have the most up-to-date knowledge.

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), digital literacy is a skill set and tool for employment and entrepreneurship (United Nations Educational 2018). Digital literacy allows individuals to interact and participate on digital platforms. The descriptions above incorporate a social aspect to the concept of digital literacy and define it as a collection of competencies that encompass various abilities to utilize digital devices, communication applications, and networks to access, manage, and evaluate, which can be employed to engage in social interactions or foster personal growth. Digital literacy and ICT literacy education in Indonesia is typically included in the IT curriculum offered in schools, focusing on technical skills. Additionally, informal blogs or portals are utilized to disseminate common knowledge in ICT (Rahmah 2015).

In education, social skill is regarded as an essential attribute for several compelling reasons. The primary focus of a teacher's role is to offer instructional support in the pursuit of knowledge, which fundamentally involves a dynamic and collaborative social exchange. Educators must observe classroom dynamics systematically, provide social contexts that facilitate learning, and establish and sustain connections with students and their parents. Furthermore, an essential responsibility of educators is to impart social skills to their students. Consequently, acquiring and instructing these abilities becomes a primary and secondary endeavour within teacher training. In recent years, the teaching profession has significantly expanded, shifting from solely focusing on instructional activities to including a wide range of multi-professional collaborative duties that require shared expertise and social skills (Tynjälä et al. 2016).

Many researchers having conducted teachers' pedagogical competence in technology stated that the subject variable emerged as the only significant predictor, indicating that STEM pre-service teachers exhibited beneficial relationships between Technological Pedagogical Content Knowledge (TPACK) components and the utilization of technology in their lesson plans. The predictive factor for the integration of mobile technology was shown to be teachers' self-efficacy (Schmid et al. 2021). Significant heterogeneity in the competencies and knowledge possessed by teaching professionals demonstrated a relatively limited range of diversity in their views. An essential outcome of this study is an enhanced comprehension of digital competence as perceived by teaching professionals (Hämäläinen et al. 2021). One could propose that in the field of teacher education, a potentially beneficial approach towards attaining proficient technology integration involves explicitly promoting teachers' personal values, with a particular emphasis on cultivating their views on the implementation of technology in educational practices (Durak 2019). They positively predicted the relationships between self-efficacy beliefs and commitment to teaching (Chesnut and Burley 2015). Teachers' knowledge and incapacity toward technology also affect their teaching practices of ICT.

Some findings mentioned above investigate how teachers exhibited beneficial relationships between TPACK components and the utilization of technology in their lesson plans, integration of mobile technology in teachers' self-efficacy, comprehension of digital competence as perceived by teaching professionals, teachers' implementation of technology in educational practices, self-efficacy beliefs and how commitment to teaching and technology affects teachers' teaching practices of ICT.

On the contrary, other studies stated that the level of teachers' self-efficacy in using information and communication technology (ICT) is associated with their perception of the quality and value of their initial teacher education (ITE) on ICT, as well as its impact on their professional development and competence (PDC). Typically, recently appointed teachers express dissatisfaction with the degree and effect of information and communication technology (ICT) instruction received throughout their teacher training (Björk Gudmundsdottir, G., & Hatlevik 2016).

This issue is essential for the involvement of multiple stakeholders. Digital literacy plays a crucial role in facilitating the proficiency of both teachers and students in utilizing software, resolving cognitive and psychomotor challenges, as well as evaluating the credibility of online information and educational resources employed by teachers.

In this study, it is necessary to investigate the factors of Indonesian teachers' pedagogical competence relating to the readiness of self–efficacy, digital literacy, attitude, and management for the teachers in Indonesia as a gap for this study. It is essential to instil this gap to conduct further research. Therefore, the objectives of this study are to investigate the readiness of self–efficacy, digital literacy, attitude, and management for Indonesian teachers' pedagogical competence.

2. Literature Review

2.1 The Teachers' Readiness in Online Learning

The notion of readiness for online learning was developed by (Warner, D., Christie, G., & Choy 1998) in their study project on Australian vocational education and training sectors. Many researchers sought to examine readiness elements that affect online-learning performance (Hung 2016)). The readiness for online learning appears to be a significant determinant of their academic achievement in online courses (Wei and Chou 2020). The concept of readiness holds significant importance as it provides the fundamental basis for developing a theoretical framework concerning the preparedness and equitable encounters associated with online instruction (Cutri and Mena 2020). Online learning readiness is the assessment of certain organizational and individual factors that should be considered and successful with the introduction of an e-learning strategy (Aldhafeeri and Khan 2016).

2.2 Digital Literacy- Self-Efficacy (DLSE)

Digital literacy has gained prominence in educational and assessment programs of various governments since the beginning of the twenty-first century, primarily due to its significance in citizenship education (Pérez-Escoda, García-Ruiz, and Aguaded 2019). The challenge in comprehending and advancing digital literacy arises from its dynamic, cross-cutting, and adaptable characteristics. The integration of digital literacy within the educational sector is inherently intertwined with the role and responsibilities of the classroom teacher (Rusydiyah, Purwati, and Prabowo 2020). One of the internal factors that can affect the teacher is self-efficacy. Self-efficacy influences thinking processes, motivation levels, and feeling states, which all affect the type of performance performed (Bandura 2012). Self-efficacy is a person's belief in being able to master a particular situation and the ability to overcome an obstacle ((Hatlevik et al. 2018);(Lauermann and König 2016). If an individual has high self-efficacy, he can face all the tasks and problems in his life (Pellas 2014); (Zee and Koomen 2016). As the competence in these constituent elements advances, the corresponding level of self-efficacy is elevated (Williams et al. 2023).

2.3 Attitude Readiness (AR)

Individuals' attitudes are shaped by affective, behavioral, and cognitive elements (Zhu et al. 2020). The affective component might be understood as the evaluative aspect of an individual's attitudes. Attitude holders engage in the process of evaluating and forming judgments about an object, depending on both evaluative and emotive factors. The behavioural component is commonly perceived as an inclination to engage in action and embodies an intentional aspect within attitudes. The study examined the attitudes of students and instructors towards the transition to online education during the COVID-19 pandemic (Hussein et al. 2020).

Based on the literature review, the hypothesis examined in the study is shown in Table 1.

Table 1: Hypothesis

No	Hypotheses
H1	Teacher readiness (TR) will significantly influennce teacher readiness in digital literacy-self-efficacy (TR-DLSE)
H2	Teacher readiness (TR) will significantly influence pedagogical competence (PC)
H3	Teacher readiness (TR) will significantly influence attitude readiness (AR)
H4	Teacher readiness (TR) will significantly influence infrastructure readiness (IR)
H5	Teacher readiness (TR) will significantly influence management support (MS)

3. Method

3.1 Research Design

The research conducted was a quantitative study employing a survey design. The survey was underpinned by multiple criteria that were advantageous in the study. This identified several key factors that contributed to the effectiveness of the research findings, including high representation of the results, low cost, ease of data collecting, positive statistical significance, low level of researcher subjectivity, and accurate research findings (Leavy 2017).

The survey data was analyzed using Structural Equation Modeling (SEM) with AMOS. Structural Equation Modeling (SEM) is regarded as the subsequent iteration of multivariate analysis within the field of study. This methodology is widely favoured among scholars and researchers to analyze data collected through surveys. The utilization of AMOS applications to adapt this structural equation modelling (SEM) method is highly suitable, as it will provide more precise outcomes (Mustafa, Nordin, and Abdul Razzaq 2020); (Collier 2020).

3.2 Participants

This study involved (n=2,788) teachers as participants throughout Indonesia. The teachers included kindergarten/preschool teachers, primary school teachers, junior high school teachers, and senior high school teachers in Indonesia. School leaders focus on developing teacher competence, especially in pedagogy and professionalism. Therefore, teachers are provided with the professional development that suits the needs of teachers and students and curriculum development. The following is participant demographic data based on gender, age, teaching experience, and latest education. Participant Demographic Data aged 20 – 60 years. Last education S1, S2 and S3.

The questionnaires were developed through 34 statements on the teachers' pedagogical competence relating to the readiness of self-efficacy, digital literacy, attitude, and management for the teachers in Indonesia. The questionnaires were used to measure the pedagogical competence of the teachers in terms of the skill aspect; the questionnaire contained (a) statements about teacher ability in managing learning, (b) statements about the application of method/technique/learning model (c) statements about teacher's communication (d) statements about understanding the characteristics of students, (e) statements about the use of learning resources and (f) statements about utilizing technology. The measurement scale used in these questionnaires was the Likert scale. In addition, the researcher also provided open questions to the mathematics teachers about the types and characteristics of training needed by mathematics teachers and the questions about the suitability of the activities that they followed with their needs.

3.3 Procedure

This research procedure consists of three main stages. The first stage is the preparation stage. At this stage, researchers identified problems or phenomena in the field. Then, researchers also conducted literature reviews from various sources, both from books and research journals. Furthermore, the researchers also asked for permission by submitting a letter of application to conduct research to the leadership at the institution where the study was held. Then, researchers began to prepare research instruments, namely questionnaires. The second stage was the data collection stage. At this stage, researchers distributed questionnaires to participants who started by filling out informed consent to be involved in this research. Before distributing the questionnaire, the researcher explained the purpose of this research and the benefits the participants would hopefully experience. The researcher said that participant honesty in filling out this questionnaire was essential because it was a self-evaluation; participants give themselves an assessment. Due to limited time and resources, the

researcher used a one-shot experiment method, namely, data collection, without formerly testing the instrument first. The third stage is data analysis after the data goes through testing using SEM PLS AMOS.

3.4 Instrument of the Research

The instrument used was a closed questionnaire relating to factors of Indonesian teachers' pedagogical competence about the readiness of self-efficacy, digital literacy, attitude, and management of the teachers in Indonesia. For the teacher self-efficacy variable, researchers used a questionnaire developed by (Tschannen-Moran, M., & Woolfolk Hoy 2001);(Tschannen-Moran, M., & Woolfolk Hoy 2007), namely the Teachers' Sense of Efficacy Scale (α = .94). The statement questionnaire contains three dimensions of teacher self-efficacy in carrying out their duties, namely self-efficacy in learning strategies, interaction with students, and classroom management. Participants were asked to measure confidence. The questionnaire consists of 34 statement items regarding the teachers' readiness in online learning: digital literacy- self–efficacy, pedagogical competence, attitude, infrastructure, and management support in Indonesia.

For this reason, the teacher readiness level instrument was developed by researchers according to the needs of research subjects, by adopting it from various sources which was then developed based on research needs during the Covid 19 pandemic. Meanwhile, (Hung 2016) divides readiness in online learning into five dimensions: (1) independent learning, (2) learning motivation, (3) computer/internet self-efficacy , (4) learner control, and (5) online communication self-efficacy.

3.5 Data Collection Process

Structural equation modelling (SEM) is an exceedingly valuable framework due to its various advantages. Firstly, it facilitates exploratory and confirmatory research by integrating self-reflection, modelling proficiency, and theoretical foundations. The approach described is practical when applied within the philosophy of discovery or confirmation frameworks. Additionally, it proves valuable in various research methodologies such as experimental or survey research, cross-sectional or longitudinal studies, and endeavours involving measurement or hypothesis testing. Furthermore, this approach can be applied within different groups and across various institutional or cultural contexts (Bagozzi, R. P., & Yi 2012). Typically, each structural equation modelling (SEM) analysis follows a series of stages, including model formulation, data collection, estimation, evaluation, and potential model modification. Most structural equation modelling (SEM) evaluations are typically performed utilizing one of the dedicated SEM software applications. AMOS represents one of the entities under consideration. The AMOS software can generate bootstrapped standard error estimates and confidence intervals for parameter estimates. AMOS offers an additional method for doing a full-information maximum likelihood estimate in the presence of missing data (Lei, P. W., &Wu 2007). The AMOS software package was utilized to conduct confirmatory factor analyses (CFA) on the scales and structural equation modelling (SEM) to investigate the interrelationships among the constructs within the suggested model.

The AMOS software initially assessed the measurement model by confirmatory factor analysis. The model delineated distinct variables, including learning goal structure, performance goal structure, teacher self-efficacy, time pressure, emotional exhaustion, work satisfaction, and motivation to leave the profession. The primary objective of conducting the measurement model test was to validate the independence of the stated elements as distinct constructs and determine the extent of correlations among these factors. Subsequently, the theoretical model was subjected to examination using the utilization of structural equation modelling (SEM). To mitigate the influence of the substantial age disparity within the sample, the age of the teachers was used as an endogenous variable in the structural equation modelling (SEM) analysis (Byrne 2010). To evaluate the adequacy of the model, we employed standard indices such as the Comparative Fit Index (CFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), with the chi-square test statistics. In the CFI, IFI, and TLI indices, it is generally accepted that values beyond 0.90 are deemed satisfactory, while values surpassing 0.95 suggest a strong alignment with the data.

Data analysis begins with testing the validity and reliability of the instrument. Then, continue with the classic assumption test, the prerequisite for regression analysis. This stage consists of four types of tests, namely normality test, multicollinearity test, heteroscedasticity test, and linearity test. The third stage is multiple linear regression analysis and hypothesis testing using the simultaneous f-test (Collier 2020).

4. Results and Discussion

4.1 Description of Results

Description of results including the readiness of self-efficacy, digital literacy, attitude, and management for the teachers in Indonesia.

Figure 1 shows that the total 2,877 respondents, there were 1,127 (39.2%) respondents aged 31-35. 794 (27.6%) respondents were between 36-40 years old. 431 (15%) respondents were 41-45 years old. 372 (12.9%) respondents were 26-30 years old. Moreover, other respondents under 12% were 56-60, 51-55, and 46-50 years old.

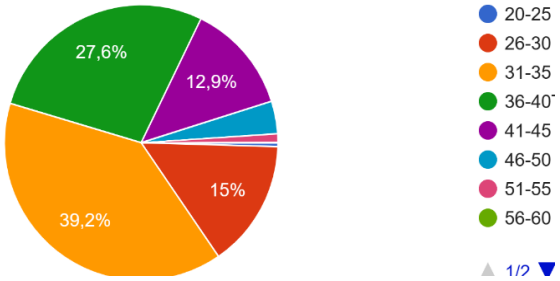

Figure 1: Age of respondents

Figure 2 shows that 356 (12.4%) respondents were kindergarten/preschool teachers. 494 (17.2%) respondents were senior high school teachers. 516 (17.9%) respondents were junior high school teachers. 1.302 (45.3%) respondents were shown as primary school teachers in Indonesia.

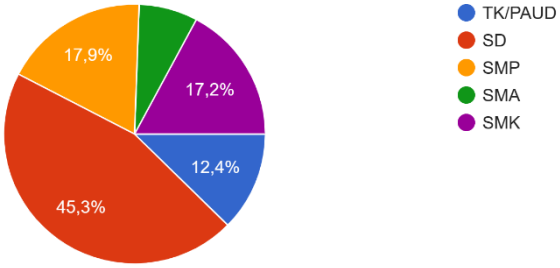

Figure 2: School Levels in Indonesia

Figure 3 shows that most respondents (96.3%), or 2,771 of 2,887 respondents, have recent education levels in S1. Based on model fit analysis in AMOS, the RMSEA value = 0.074 is obtained, which is smaller than 0.08, indicating that the model can be said to be a reasonable (plausible) representation of the data (Hair, J. F., Patel, M. L., & K. 2014).

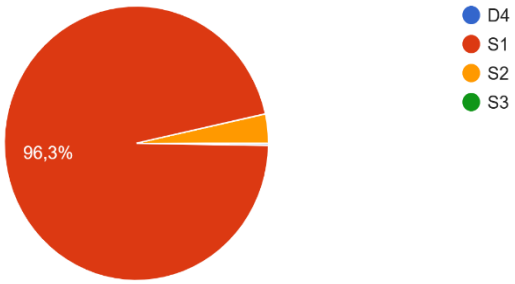

Figure 3: Recent Education of Respondents

An RMSEA value below 0.08 indicates that the model is adequate in representing the data. Specifically, the relationship between constructs, dimensions and their respective indicators is appropriate or appropriate in representing the data. This can be seen in Table 2.

Table 2: Reasonable (plausible) representation of the data

Model	RMSEA	LO 90	HI 90	CLOSE
Default model	**0,074**	0,073	0,075	0
Independence model	0,201	0,2	0,202	0

To ensure that the data can be represented reasonably using Structural Equation Modeling (SEM) with AMOS. This is needed to do the following steps: data distribution check, normality check, missing data management, model fit check, use of appropriate estimation methods, use of feature graphs and trees (see figure 4).

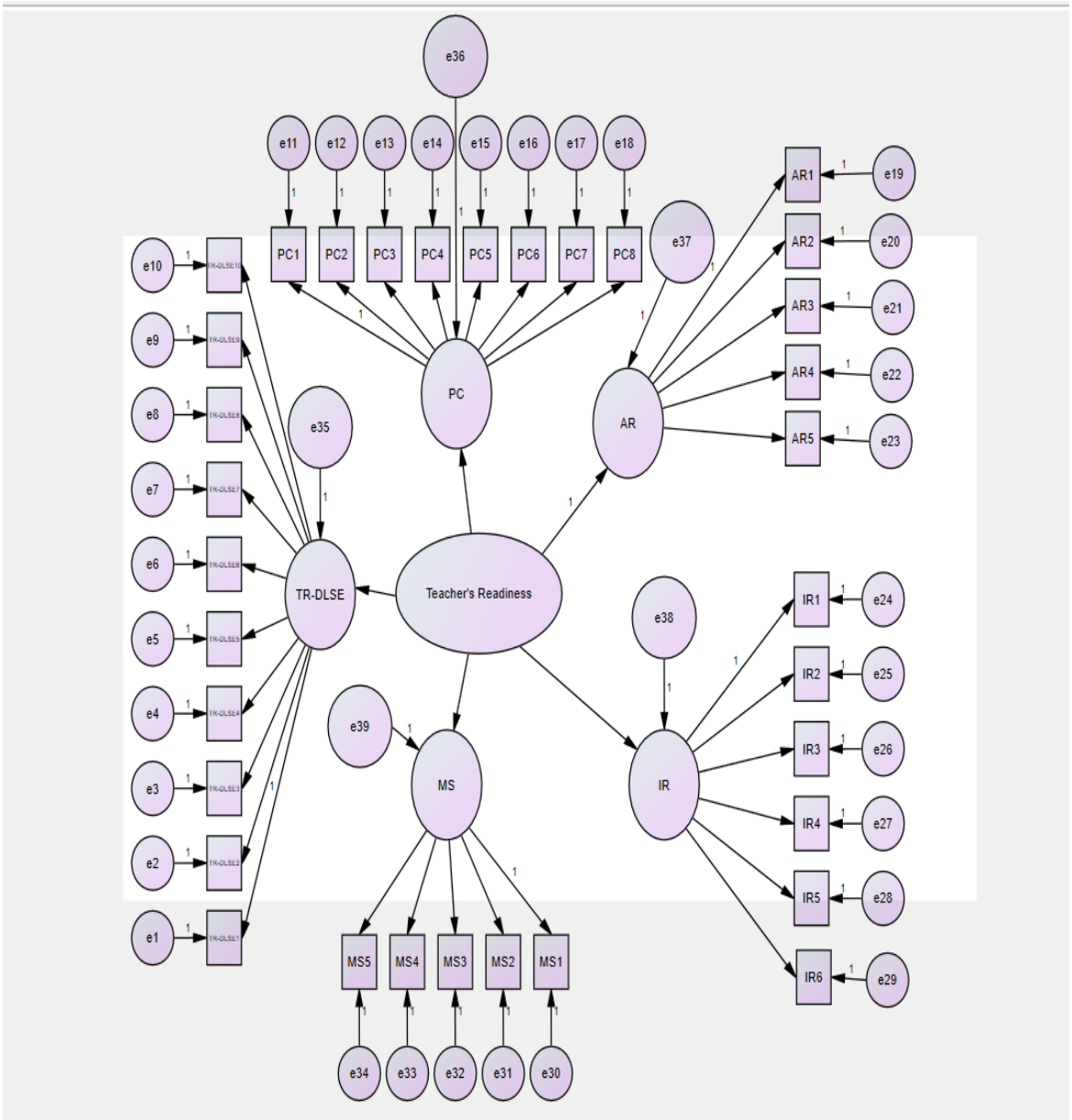

Figure 4: Reasonable representation of the data by using SEM-AMOS

In the Standardized Regression Weight (see table 3), the factor loading (Estimate) values are all above 0.5, indicating that the items can explain the indicators well and the hands can explain the construct well. By definition, factor loading (FL) is the magnitude of the correlation between the hand and its latent construct. For

example, TR1 (item 1) has an FL value of 0.619; this means that the correlation between TR1 and the indicator, namely TR, is 0.619.

The square of FL simply shows how much TR1 influences TR. Specifically, the court of FL shows the percentage of variance in the variable (indicator) that can be explained by the factor (item). In TR1, the square of 0.619 = 0.38, which shows that TR1 influences 38% of the variation/difference in TR data (see Table 3).

Information:

TR-DLSE : Teacher Readiness in digital literacy-self-efficacy

PC : Pedagogical Competence

AR : Attitude Readiness

IR : Infrastructure Readiness

MS : Management Support

Table 3: Standardized Regression Weight

Indicators		Construct/Indicator	Estimate	Quadrat Estimate
PC	<---	Teachers' readiness	0.924	0.85
IR	<---	Teachers' readiness	0.647	0,42
MSR	<---	Teachers' readiness	0,718	0,52
TR	<---	Teachers' readiness	0,763	0,58
RA	<---	Teachers' readiness	0,966	0,93
TR1	<---	TR	0,619	0,38
TR2	<---	TR	0,729	0,53
TR3	<---	TR	0,732	0,54
TR4	<---	TR	0,764	0,58
TR5	<---	TR	0,64	0,41
TR6	<---	TR	0,614	0,38
TR7	<---	TR	0,694	0,48
TR8	<---	TR	0,756	0,57
TR9	<---	TR	0,707	0,50
TR10	<---	TR	0,533	0,28
PC1	<---	PC	0,56	0,31
PC2	<---	PC	0,757	0,57
PC3	<---	PC	0,642	0,41
PC4	<---	PC	0,815	0,66
PC5	<---	PC	0,853	0,73
PC6	<---	PC	0,821	0,67
PC7	<---	PC	0,812	0,66
PC8	<---	PC	0,788	0,62
RA1	<---	RA	0,772	0,60
RA2	<---	RA	0,797	0,64
RA3	<---	RA	0,754	0,57
RA4	<---	RA	0,64	0,41
RA5	<---	RA	0,634	0,40
IR1	<---	IR	0,841	0,71
IR2	<---	IR	0,843	0,71

Indicators		Construct/Indicator	Estimate	Quadrat Estimate
IR3	<---	IR	0,81	0,66
IR4	<---	IR	0,814	0,66
IRI5	<---	IR	0,843	0,71
IRI6	<---	IR	0,787	0,62
MSR1	<---	MSR	0,793	0,63
MSR2	<---	MSR	0,808	0,65
MSR3	<---	MSR	0,726	0,53
MSR4	<---	MSR	0,763	0,58
MSR5	<---	MSR	0,772	0,60

Two thousand seven hundred eighty-eight teachers in Indonesia were engaged as participants throughout various regions. The findings indicate the association between the five indicators (TR: teacher readiness regarding digital literacy and self-efficacy, PC: pedagogical abilities, RA: readiness in terms of attitude, IR: infrastructure readiness, MSR: management support readiness), and the concept of teacher readiness in online learning, the indicator of attitude demonstrates the most muscular explanatory power compared to the remaining four hands. The square of the factor loading (FL) on the readiness of attitude is 0.93, which indicates that the factor loading can account for 93% of the variance in the readiness of mentality. The attitudinal readiness of instructors in Indonesia has been identified as a significant factor influencing their readiness for online learning (Prior et al. 2016).

This study investigated the teachers' readiness in online learning: digital literacy- self–efficacy, pedagogical competence, attitude, infrastructure, and management support in Indonesia. We further tested the relations among the variables using SEM with AMOS. The significance of this research field stems from the notable phenomenon of teacher readiness. There is a pressing need for a more comprehensive understanding of the factors contributing to teachers' pedagogical competency, specifically teachers' self-efficacy, digital literacy, attitude, and managerial skills. The structural variables model was found to be explanatory based on the results obtained from the SEM analysis with AMOS. The empirical model, reporting standardized regression weights, is displayed in Figure 4.

The findings show the teachers' readiness in terms of attitudes, such as: teachers can provide many variations of learning in online learning; online learning applications are easy to use; teachers can collaborate with students in online learning; online learning makes me more creative in teaching. Even though the pandemic is over, the teachers will still use online learning in teaching.

Some findings supported this study, stating that the impact of school climate on work satisfaction was favourable, with self-efficacy acting as a partial mediator. The relationship between collective efficacy in student discipline and job satisfaction or burnout was not established to be significant. The presence of self-efficacy in managing one's behaviour has been found to have a favourable impact on an individual's level of job satisfaction (Malinen and Savolainen 2016). Education is a realistic effort wherein teaching is regarded as both an art and a science, encompassing a balanced amalgamation of information and abilities (Nurhikmah H, Abdul Saman, Pattaufi and Mawarni 2023). Nevertheless, it is essential to note that neither of these components alone is unsatisfactory (From 2017). The extent to which teachers' confidence in utilizing and implementing technology was influenced by their participation in continuous professional development interventions. This finding highlights the importance of persistent interventions in enhancing teachers' self-efficacy in effectively utilizing technology for professional purposes (Gomez et al. 2022).

The findings reported in this literature review contribute to advancing theoretical understanding of the intricate correlation between teachers' pedagogical views and educational advances, particularly concerning technology (Tondeur, Ertmer, and Quinn 2017). The constructs of teacher self-efficacy, academic self-efficacy, and computer self-efficacy have been identified as significant determinants in shaping the attitudes of prospective teachers towards adopting and utilizing computer-supported education.

A comprehensive understanding of teachers' self-efficacy beliefs necessitates consideration of environmental factors, as these beliefs are intricately intertwined with the surrounding context (Bandura 2010). The level of self-efficacy in online technologies appeared to be significantly increased (Ozerbas and Erdogan 2016). Disregarding the social context of teaching would undermine the effectiveness of teaching tasks. Our

comprehension of the motivational mechanisms suggests that they influence teachers' growth of their self-beliefs regarding their capabilities, engagement, and pleasure in the workplace (Granziera and Perera 2019). The present study results indicate a beneficial connection between school climate and teacher self-efficacy in management. They align with previous research that has also demonstrated a link between teachers' working conditions and their self-efficacy (Malinen and Savolainen 2016).

When examining the relationship between the five indicators (TR: Teacher readiness in terms of digital literacy and self-efficacy, PA: Pedagogical abilities, RA: Readiness in terms of attitude, IR: Infrastructure readiness, MSR: Management support readiness), and the concept of teacher readiness in online learning, the attitude indicator exhibits the highest level of explanatory capability in comparison to the other four hands. When squared, the factor loading (FL) on the readiness of attitude yields a value of 0.93. This indicates that the factor loading may explain a significant portion of the variability in the readiness of philosophy. The attitudinal preparedness of instructors in Indonesia plays a crucial role in determining their readiness for engaging in online learning.

4.2 The Attitude Readiness of Teachers in Indonesia Influence Teachers' Readiness for Online Learning

Questionnaires were administered to 2,788 participants to gather detailed information about the teachers' readiness in online learning: digital literacy- self–efficacy, pedagogical competence, attitude, infrastructure, and management support in Indonesia. These findings of the study show that the attitude readiness of teachers in Indonesia has been identified as a significant factor influencing their readiness for online learning.

Other research supports this study, stating that teacher readiness is vital for educational organizations and that pre-service teachers possess higher levels of teacher readiness and sufficiently positive attitudes (Polat 2022). The study's findings provide valuable insights for teachers and educational institutions in comprehending students' perspectives on online learning in uncommon situations (Hussein et al. 2020). According to a recent online survey conducted among a sample of 151 postgraduate business students, the findings indicate a noteworthy relationship between good student attitude and digital literacy, both of which have a major impact on self-efficacy (Prior et al. 2016). The participants had generally positive attitudes towards online learning, which further improved upon completion of the course. Additionally, the participants' sustained desire to engage in online learning was found to be significantly influenced by four self-regulatory characteristics and their attitudes towards the method of learning (Zhu et al. 2020).

The constructs of teacher self-efficacy, academic self-efficacy, and computer self-efficacy have been identified as significant factors in determining prospective teachers' attitudes towards the adoption and utilisation of computer-supported education. The computer and internet self-efficacy of students has a significant role in their preparation for online learning (Zhu et al. 2020). This readiness, in turn, has a mediated effect on various aspects of online learning, including views of the learning experience and scores in online discussions. Additionally, it also influences the overall happiness of students with the course (Wei and Chou 2020). Moreover, the level of preparation among teachers in utilizing internet technology appeared to be quite high. These findings emphasize the importance of providing support to instructors in improving their self-efficacy in managing student behavior.

In summary, this study makes four contributions. First, this study addresses a notable need in the field of online education by examining the impact of digital literacy and teachers' attitudes in Indonesia teachers' readiness. Second, this study examines the cascading impacts of teachers' attitude readiness on online learning. Third, the present study examines the impact of teachers' attitude readiness on many aspects of online learning, including pedagogical competence, infrastructure readiness, management support readiness, and teacher readiness. Fourth, the study provides valuable and constructive insights for both practical application and theoretical understanding.

4.3 The Practical Implication of this Study

The results of this current study indicate that every aspect of the indicator of attitude demonstrates the most muscular explanatory power compared to the remaining four variables, namely digital literacy-self-efficacy (TR-DLSE), pedagogical competence (PC), infrastructure readiness (IR), and management support (MS) in online learning in Indonesia. This study can be applied in online learning for educators and the field of teachers' education. In order to help users understand the importance of e-learning, teachers can modify the integration of e-learning by putting in place digital literacy-self-efficacy, pedagogical competence, infrastructure readiness, and management support in online learning. Those highlight the need to assist teachers in enhancing their self-efficacy in behaviour management. The degree to which Indonesian educators are prepared to participate in online learning is largely dependent on teachers' attitude. Furthermore, this research can be implemented in the digitalization of the education sector.

5. Conclusion

In Indonesia, similar to several other developing nations, it is vital to thoroughly deliberate on all issues about education, as education serves as a significant catalyst for progress. Moreover, educators have a critical role in this context. Educators' expertise, pedagogical skills, engagement with the students, and even their convictions can significantly impact the academic accomplishments of learners. All teachers as respondents participate in the study to conduct across various regions in Indonesia. The findings indicate that the association between the five indicators: teacher readiness in digital literacy-self-efficacy (TR-DLSE), pedagogical competence (PC), attitude readiness (AR), infrastructure readiness (IR), and management support (MS), and the concept of a teacher are ready in online learning, the indicator of attitude demonstrates the most muscular explanatory power compared to the remaining four variables. The squared factor loading (FL) on the readiness of attitude is 0.93, which shows that the factor loading can account for most of the variance in the preparedness of mentality. The attitudinal enthusiasm of instructors in Indonesia is a significant factor influencing their preparedness for online learning. The readiness of teachers, as regards their attitudes, include their ability to offer diverse learning options in the context of online learning. Additionally, it involves their proficiency in utilizing user-friendly online learning tools, as well as their capacity to engage in collaborative efforts with students inside the online learning environment. Engaging in online learning enhances pedagogical creativity. Despite the ending of the pandemic, educators will continue to utilize online learning as a pedagogical approach.

This study focuses on teachers' readiness in digital literacy-self-efficacy (TR-DLSE), pedagogical competence (PC), attitude readiness (AR), infrastructure readiness (IR), and management support (MS) in online learning. A recommendation for further researchers would be to investigate in depth the university students, education staff, and lecturers for the readiness of self–efficacy, digital literacy, attitude, and management for pedagogical competence in Indonesia in order to gain different results and to improve the results of this study. Moreover, future studies should use a larger research sample and look at additional characteristics not included in the variables of study that may impact online learning.

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Roles of Chatbots in Gamified Self-Regulated Learning System to Enhance Achievement Motivation of Learners in Massive Open Online Courses

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Abstract: The integration of self-regulated learning, which allows learners to set goals and plan their learning according to their needs and interests, with the concept of gamification creates challenges and engagement in learning. Additionally, the use of chatbots to provide real-time feedback can stimulate learning and significantly enhance achievement motivation in massive open online courses (MOOCs). In this study, we present a learning innovation system in the form of a gamified self-regulated learning (GSRL) system to address the low completion rate and high dropout rate of learners in MOOCs. Our system enhances learners' achievement motivation. The objective of this study is to examine important factors in the development of GSRL systems to enhance achievement motivation for MOOCs and to study the results of using the GSRL system with learners in higher education. This research adopts a research and development approach, collecting both quantitative and qualitative data. Quantitative data were collected from questionnaires, and qualitative data were collected from expert interviews to inform the design and development of the GSRL systems. Quantitative data collected from 898 higher education students were analyzed using confirmatory factor analysis. The GSRL system was then used experimentally with 205 Thai MOOC students. It was found that the overall achievement motivation following this study was significantly higher than the rate before studying. Classification by age showed that learners aged 20 years and older developed achievement motivation that was higher than that of those under 20 years old. The results of the analysis of the achievement motivation correlations in regard to learners' opinions and learning behavior observation found that learners with high achievement motivation tend to exhibit behaviors that reflect this.

Keywords: MOOCs, Achievement motivation, Self-regulated learning, Gamification, Wearable device

1. Introduction

Many countries around the world have been promoting educational innovation through the application of digital technology for learning at all levels to enhance lifelong learning (Jones and Sharma, 2019; Lara-Prieto et al. 2019; Xu et al., 2020; Li et al., 2022). The introduction of a range of portable electronic devices to the study context has changed the way in which students learn, allowing them to learn anywhere and anytime by using a variety of mobile devices. Students in the digital age expect interactive technology media and learning challenges (Shahmohammadi et al., 2017; Babic, Gaspar, and Satala, 2018), as well as flexible learning and the use of a learning system that can be accessed anywhere and anytime (Al-Soh and Zualkernan, 2017; Royal Thai Government Gazette, 2018; Xu et al., 2020). This accessibility leads to the development of achievement motivation among learners (Huang and Lin, 2017; Pambudi, Bachtiar, and Pradana, 2019). Instructors in higher education should be aware of learning environments that focus on the context of massive open online courses (MOOCs) to expand learning opportunities by means of mobile devices that the students already have. The bring your own device approach, combined with adult learning concepts such as self-regulated learning (SRL), will result in maximized learning potential (Khlaisang, 2013; Theeraroungchaisri and Khlaisang, 2019; Wong et al., 2019; Galindo, Romero-Rodriguez, and Montoya, 2019; Jansen et al., 2020; Lee, Watson, and Watson, 2020; Moreno-Marcos et al., 2020; Shi et al., 2024). On this note, a study from Malaysia examined the role of SRL in relation to student satisfaction with a Malaysian MOOC. The components of SRL consist of (1) time management, (2) planning, (3) self-evaluation, and (4) help-seeking. The results of this indicate that the SRL components apart from help-seeking are important factors for explaining learners' satisfaction in a MOOC (Zalli, Nordin, and Hashim, 2019).

In addition, research has been conducted on the relationship between self-efficacy, task value, and SRL in MOOCs at Midwestern University, USA, developed on the edX platform. The results showed a positive correlation between self-efficacy and the use of SRL. A positive correlation was also found between task value

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and the use of SRL. SRL use greatly depended on self-efficacy and task value. In addition, learners who had high task value showed statistically significantly higher average SRL learning scores than those who had low task value (Lee, Watson, and Watson, 2020). This result is in agreement with a study conducted at the Open University, UK, which investigated SRL in face-to-face language modules with MOOCs. The results showed that integrating MOOCs into instructional language modules could result in innovative and blended learning. This offers students a direct approach to instruction allowing them to continue in their independent learning. In addition, students have an online learning engagement that supports their SRL behavior while studying at their own pace and practicing their language skills (Gafaro, 2019).

Thailand Cyber University, a project developed under the Thailand Ministry of Higher Education, Science, Research and Innovation, launched a Thai MOOC in March 2017 on the Open edX platform, an open-source platform for digital learning that aims to empower sustainable lifelong learning in Thailand through the provision of free access to quality educational resources. This is a national platform for course content, learning activities, and evaluations, with over 1.5 million members enrolled and more than 1.4 million certificates issued, as of December 2022. The platform also hosts over 600 courses co-created by official partners from the public and private sectors within Thailand and internationally (Thammetar et al., 2022). However, tools are still lacking for increasing learning achievement rates and enhancing students' motivation for online learning. A review of the literature review on learning design in MOOCs in higher education showed that SRL is a learning process in which learners' ability to plan, supervise, monitor, and choose suitable learning strategies is influenced by motivation and the learning environment, thereby affecting their ability to achieve their desired learning goals (Boekaerts, 1999; Pintrich and Zimmerman, 2000; Boekaerts, Pintrich, and Zeidner, 2005; Boekaerts and Cascallar, 2006; Zakaria, Anas, and Oucamah, 2024). Gamification can be deployed to enhance the achievement motivation for learning. The use of game concepts for organizing activities may consist of components such as badges, competitions, participation, assigned tasks, and appropriate feedback for learning. Learners are entertained through participation and encouraged to learn (Ghasemi et al., 2011; Bipp and van Dam, 2014; Smith, 2015; Sharma and Sharma, 2018). However, even if the instructor uses SRL and gamification concepts in their instruction, a real-time tool to monitor individual progress in learning through MOOCs is still lacking.

Chatbots and wearable devices are in widespread use in daily life. Chatbots have been used throughout the commercial sector. Wearable devices (Zarouali et al., 2018; Pereira and Díaz, 2019; Van den Broeck et al., 2019), such as smart watches, can be used to control, track, and alert users in their daily activities, such as exercise (Souza et al., 2017; Pambudi, Bachtiar, and Pradana, 2019) and medical care, elderly health care in particular (Garg, 2018; Chung and Park, 2019; Sheth, Yip, and Shekarpour, 2019). However, this technology remains uncommon in education, especially in the Thai context. Thus, this study uses ubiquitous learning as a learning environment that employs computers able to access content anywhere and anytime. Learning environments can be altered in response to the real situation and to offer learning flexibility (Khlaisang, 2018). This provides students with the freedom to learn in an environment that is adaptable to their individual needs. Innovation in this research will help fulfill the process and increase achievement motivation. This can result in the success of learning in MOOCs as well (Sheth, Yip, and Shekarpour, 2019; Zobel, 2023).

This study was conducted to answer the following research questions: (1) What are the essential conditions and requirements for effectively implementing a gamified self-regulated learning (GSRL) system within the Open edX platform for MOOCs in Thailand, considering the principles of adult learning theory (andragogy) and personalized learning?; (2) What are the key factors influencing the development of GSRL systems that significantly impact achievement motivation among Thai learners in MOOC environments?; (3) How do the features of GSRL systems in ubiquitous learning contexts bolster achievement motivation in MOOC learners?; and (4) What is the impact of studying in a GSRL system on learners' achievement motivation in MOOC learning contexts, both before and after their engagement with the system? The theoretical framework of this study is shown in Figure 1.

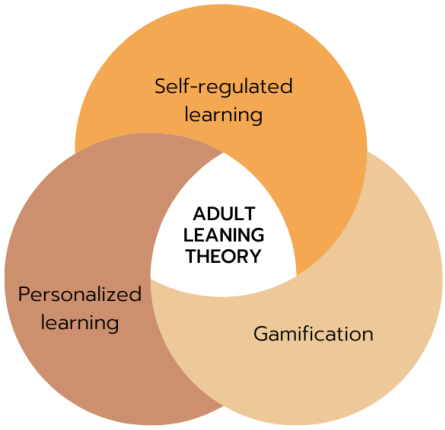

Figure 1: Theoretical framework

By combining Personalized Learning, Self-Regulated Learning, and Gamification, this theoretical framework supports the development of a dynamic and engaging educational environment. It encourages learners to take ownership of their educational journeys, fostering motivation, adaptability, and deeper learning experiences.

2. Literature Review

2.1 Andragogy and Personalized Learning

Personalized learning allows learners to develop basic knowledge, skills, and abilities at their own pace. This is consistent with the theory of andragogy, which suggests that adults learn from their individual experiences. As noted for both approaches, critical factors, such as time, access to learning resources, motivation, and available learning resources, significantly influence learners' learning (Wozniak, 2020). Stoten (2020) found that in a personalized learning context, learners set their own goals, which is the key principle in SRL and andragogy.

2.2 Self-Regulated Learning

SRL is the process by which learners learn, think, and act in the context of their study, entailing planning, following up, monitoring, evaluating, and selecting appropriate learning strategies. A strong degree of motivation and a suitable learning environment can enable learners to achieve their learning goals (Panadero, 2017; Stoten, 2020; Zimmerman, 2000). This aligns with the research by Shi et al. (2024), who studied the behavioral patterns of learners that led to successful learning in MOOCs. Their findings indicated that self-regulation was a crucial factor for successful learning. Similarly, Zhao et al. (2024) stated that self-regulated learning served as a mediator for controlling positive emotions in MOOC learning. Additionally, Han et al. (2023) investigated learners' needs in MOOCs and found that learners desired to use chatbots to help them access useful information for their studies.

2.3 Gamification

In gamification, elements, and mechanisms of gaming are used in other contexts, such as in education, to enhance attention and motivation, leading to behavior modification in the form of increased participation and engagement (Antonaci et al., 2017; Klamma and Arifin, 2017; Li et al., 2022). This aligns with the research by Cheng (2024), which studied the role of gamification and personalization in MOOCs. The findings showed that gamification and personalization could enhance learning engagement, learning persistence, and learning outcomes. Similarly, Zakaria, Anas, and Oucamah (2024) reviewed the literature on the use of gamification in MOOCs for boosting motivation and engagement and reducing dropout rates. The study found that gamification elements such as badges, levels, leaderboards, challenges, and rewards significantly affected student motivation and engagement and reduced dropout rates in MOOCs.

3. GSRL System

Chatbots are considered a technology-enhanced learning tool in MOOCs that support personalized learning, encourage learners' engagement, and improve convenient access to information. This leads to an enhanced learning experience on MOOCs (Zobel, 2023), consistent with the aforementioned research. The GSRL system developed and deployed in this study is called iChat Smart. It aims to enhance the achievement motivation for

MOOC learners through an innovation in the use of wearable technology devices with the aim of tracking learning through the gamification. It acts as a personal assistant for students seeking to enhance their learning with the use of chatbots with a smart watch to set goals (iSet, iSchedule, iFollow), monitor learning progress, and receive automatic notifications (missions, levels, and badges). It has the following features and characteristics.

3.1 iChat Smart Helps and Facilitates Students

Students can communicate with chatbot on a smart phone via Facebook Messenger. A smart watch is connected through the Android wear application, which supports both Thai and English. From this, the system shows three menus for the students to choose from My Courses, Profile, and Goals and Settings (See Figure 2).

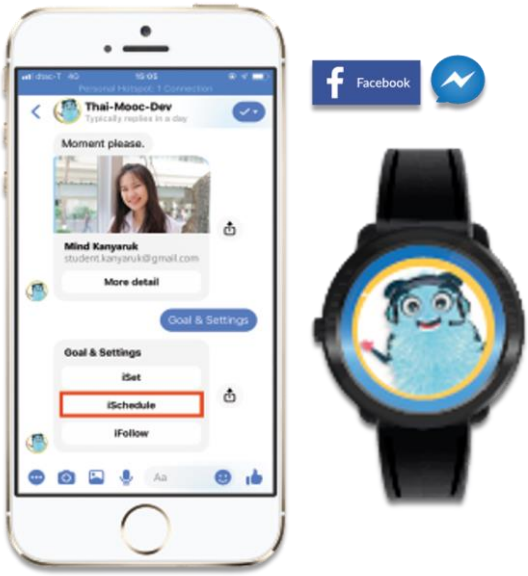

Figure 2: iChat Smart is a gamified wearable tracking tool developed to enhance learning engagement via a Chatbot personal assistant (goal setting through iSet, iSchedule, and iFollow; learning progress; and notifications in the form of missions, levels, and badges)

The chatbot system in this study had the role of a personal learning assistant able to be carried with students anywhere and used anytime, as many research studies found that it is helpful for students to use a tool that can monitor their learning and create motivation for learning (Winne, 2011; Adam et al., 2017).

3.2 iChat Smart Monitors Learning Process

When learners choose the My Courses menu, the chatbot system shows all the courses for which they registered. The sub-menus include More Detail and Learning Process, where students can view their progress in a course, whenever they wish. The system assigns levels and badges according to the concept of gamification (Ghasemi, 2011) in each course to create challenges and stimulate learning achievement motivation in learners (see Figure 3).

The Goal and Setting menu can be used by students to edit their profiles, create their class schedules, and set works for each course to which they are registered. Learners can use iSet to edit their profiles. Learners can create their class schedules and notifications in iSchedule. iFollow is used to create a class schedule and notifications in the form of a timetable. (See Figure 4).

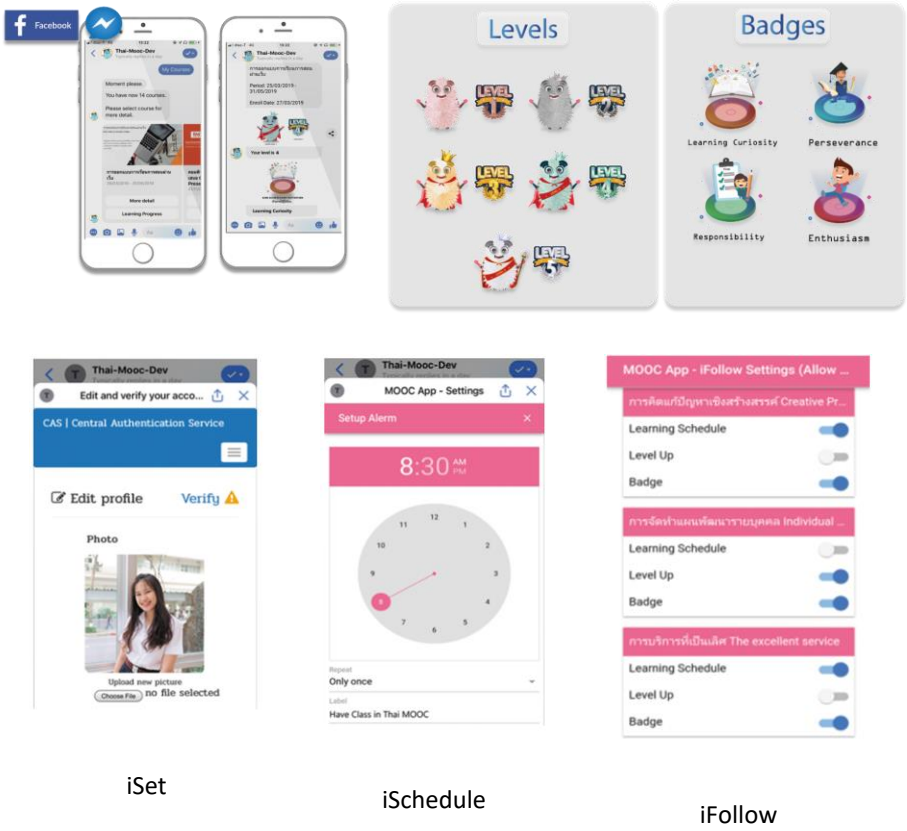

Figure 3: (Up) My Course menu, used to monitor learning progress and badges received. (Down) Goal and Setting menu, used to edit the Profile, create class schedule, and find assignments for each course registered

3.3 iChat Smart to Send Automated Notification

Learners can set the courses that they are registered to by using the chatbot with the smart watch. The smart watch application focuses on goals and settings in terms of learning goals and notifications to encourage students to learn continuously and achieve their learning goals (Figure 4).

Figure 4: Real-time notification. Use of the smart watch focuses on goal and settings and notifications to encourage students to learn continuously and to achieve their learning goals

4. Method

This study is research and development (R and D) research comprising four stages: Stage 1—Instructors' and learners' opinions on the conditions and needs of the GSRL system. Confirmatory factor analysis (Hair, 2010) was conducted using multi-stage sampling by region, followed by quota sampling by region and simple random sampling. Data was collected from 898 learners nationwide. Stage 2—Development of the GSRL system and quality assessment by five experts. Stage 3—Implementation of the GSRL system. The system was tested with 205 learners selected through purposive sampling based on criteria such as readiness to use technology tools and willingness to participate in the research. Stage 4—Presentation and refinement of the GSRL system. The

results from Stage 3 were used to make improvements, and the system was evaluated and certified by five experts.

4.1 Stage 1: Instructors' and Learners' Opinions on the Conditions and Needs of the GSRL System

Quantitative data were collected from 898 higher education students via an online questionnaire, which comprised (1) basic information of the respondents, (2) conditions and needs for the development of the GSRL system using a 5-point rating scale, and (3) a study of confirmatory factors for the development of the GSRL system using a 7-point rating scale, and the validity was 0.99. The resulting data were analyzed using descriptive statistical analysis of PNI modified (Priority Needs Index Modified) to identify the needs based on students' assessments of the existing condition and the desirable condition, comparing the two to highlight the differences and determine the development needs (Wongwanich, 2019). Additionally, confirmatory factor analysis (CFA) was conducted for the development of the GSRL system. Qualitative data were also collected from experts.

4.2 Stage: 2 GSRL System Development

Information from Stage 1 was used to design a draft of the system features and interface. Five experts specializing in self-regulated learning, gamification, or MOOCs reviewed the draft and adjusted it according to their suggestions to develop the system and user manual. The evaluation tool used was a 5-point rating scale with a validity of 1.00. The data were then analyzed by calculating the mean and standard deviation (SD).

4.3 Stage 3: Using the Results of the GSRL System

The researcher tested the system with a sample of 205 students enrolled in three courses on the Thai MOOC platform: (1) CU 016 Academic Presentation Techniques, (2) CU 020 Web-Based Learning Design, and (3) SWU 011 Infographic Design. The development of gamification and instructional content relied on the voluntary contributions of instructors, emphasizing lectures and practical exercises. Subsequently, data were collected from learners using a self-assessment achievement motivation test, utilizing a 5-point rating scale covering aspects such as learning eagerness, diligence, and enthusiasm, both before and after the study period. The self-assessment instrument had a validity of 0.99. Behavioral observation and learning traces were conducted for each student in the Thai MOOC, employing a behavior observation form. Data were analyzed using one-way ANOVA statistics.

4.4 Stage 4: Presenting the GSRL System

The findings from Stage 3 were utilized to enhance both the GSRL system and its instructional manual. The system underwent evaluation by experts specializing in self-regulated learning, gamification, or MOOCs, utilizing the GSRL system validation form, a 5-point rating scale with a validity of 1.00. Data analysis involved calculating the mean and standard deviation (SD). Subsequently, the system was made accessible for download on the Google Play Store.

5. Results

The study of the GSRL system was to enhance the achievement motivation in reference to MOOCs to address the research goals. Basic information on respondents totaled of 898 students in this study is shown in Table 1.

Table 1: Basic information of questionnaire respondents (n = 898)

Details	**Percentage**
Age	
21 years	34.9
20 years	27.8
Less than 20 years old	20.8
More than 20 years old	16.5
Educational level	
Bachelor's degree	69.4
Below bachelor's degree	30.1
Graduate degree	0.5

Details	Percentage
University location	
Northeast	25.6
North	25.4
Central	24.6
South	24.4

5.1 Research Question 1: What are the Existing Conditions and Needs That can be met Using a GSRL System That can be Integrated Within the Open edX Platform for MOOCs in Thailand?

To address this question, research was conducted to establish the opinions of instructors and learners on the conditions and needs that can be met by the GSRL system. The study results are divided into two parts, with the following details:

1. Basic information on respondents. A total of 898 students (details in Table 1) participated, including 601 (66.9%) females, and 297 (33.1%) males. Of these, 88.8% reported that they had access to computers for their own use, 99.4% of which could connect to the internet. Then, 99.4% of respondents reported having a smartphone for their own use. Most respondents indicated that they used the Android operating system on their devices. The most commonly used wearable device was a smart watch that can connect to a smart phone and perform email and activity alert notification. Of the smart phones and wearable devices used by our respondents, 82.4% could connect to the internet. Respondents reported an average of 10.12 years of experience in using computers, 8.11 years of using smart phones, tablets, and wearable devices, and 9.54 years using the internet.

Experience with chatbots was reported by 92.1% of the respondents, with Facebook being the most commonly used platform for engaging with them. In addition, 55.2% of respondents had studied via open online learning and 42.4% of them studied in a Thai MOOC (most commonly), followed by Khan Academy, Skillshare, and Coursera (least commonly). Most study for 1 hour, 1 or 2 times per week. The topics that the respondents studied most were primarily computer related, followed by science and foreign languages. Most respondents studied freely gain more knowledge in the course in which they are interested, as well as to apply and extend their knowledge and conveniently access information and knowledge at all times, respectively.

It was found that most participants, 86%, were successful in their studies in MOOCs. The factors resulting in learning success were concentration and focus on education, followed by diligence and self-discipline, as well as learning media that is well designed and interesting. It was found that lack of discipline in education, fatigue, and discouragement are the top factors in lack of success in studying in the MOOC context, followed by a lack of concentration and inattention and poor internet connections.

2. The condition and needs of the GSRL system analysis was used to identify needs. By this means, it was determined that students needed to learn more in the context of ubiquitous learning. Students had experience in learning through the use of wearable devices, such as a smart watch, and use self-direction for learning.

5.2 Research Question 2: What are the Important Factors in the Development of a SRL System (or GSRL System) That can Affect Achievement Motivation for Learners who are Engaged in Thai MOOC Online Learning?

A CFA was conducted on the design of the GSRL system. The results showed that systems can be comprised of eight components, including 1) teaching methods and technology that support achievement motivation (TEACH), 2) a ubiquitous environment (ENVI), 3) meaning and the concept of gamification (CONCEPT), 4) wearable device (WEAR), 5) learning planning (PLAN), 6) gamification itself (GAME), 7) the learning process (LEARN), and 8) learning goals (TARGET), as shown in Figure 5.

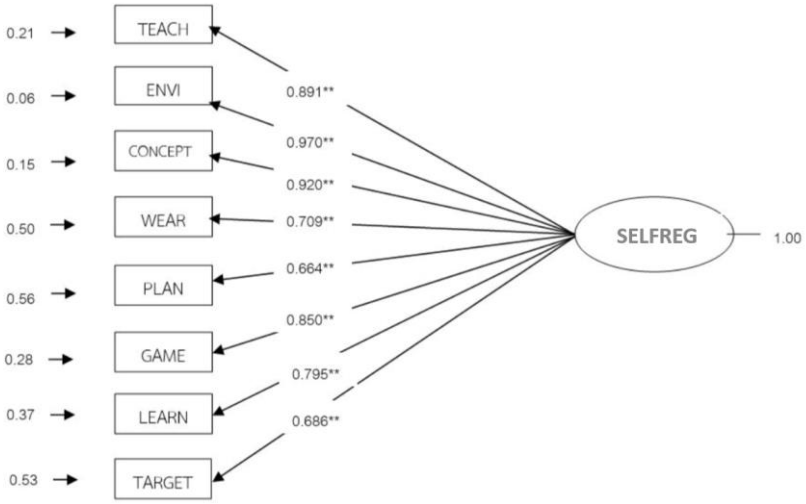

Figure 5: Confirmatory factor analysis of the design of the GSRL system

5.3 Research Question 3: What are the Necessary Features of a GSRL System in the Context of Ubiquitous Learning to Strengthen Achievement Motivation for MOOC Learners?

The GSRL system adopted in this study, called iChat Smart, was designed to enhance the achievement motivation of MOOC learners. Its design and development were in line with the eight components reported by CFA. Thus, the system consisted of four sub-systems: (1) a chatbot system for administrators and instructors, (2) a chatbot system for users (students), (3) a smart watch OS, and (4) a back office (web browser).

The system attributes have three parts, namely, (1) the plug-in program for instructors and learners in Thai MOOCs, (2) a chatbot system using Facebook Messenger that is linked to the Thai MOOC fan page, and (3) a notification system alerting students via wearable devices on the Android operating system, which is provided in terms of a collaboration between a chatbot on Facebook Messenger and an Android smart watch that allows users to receive notifications from Thai MOOCs in a convenient way. User information, registered courses, and learning progress can be viewed. The application can be downloaded from the Google Play Store.

Using iChat Smart, course instructors can set schedules, levels, and badges, according to the learner's progress or when learners are able to complete assignments via the web application. Students can choose to follow the instructor's schedule or edit the schedule in a way that is more convenient to them. In addition, iChat Smart is compatible with the use of Facebook Messenger on a mobile device or on a computer, via the Facebook website. Students can track their learning progress during the course. The levels and badges that students earn are shown in Figure 6 and 7.

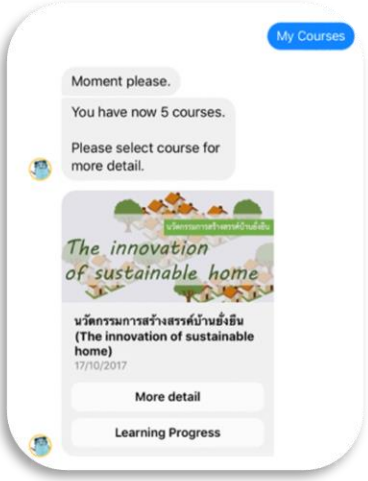

Figure 6: Chatbot system (via Facebook Messenger application) for students

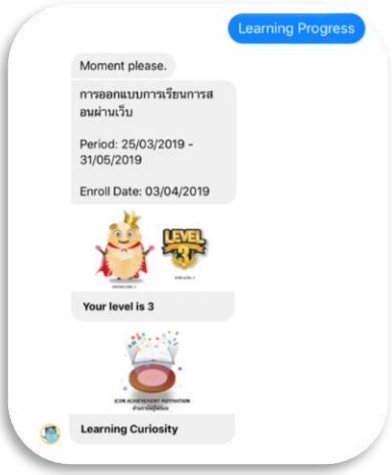

Figure 7: Example of earning levels and badges of students through the chatbot

In the diagrams and components of the iChat Smart system, Figure 8 shows the logical view, Figure 9 shows the use case, and Figure 10 shows the data dictionary for the iChat Smart system.

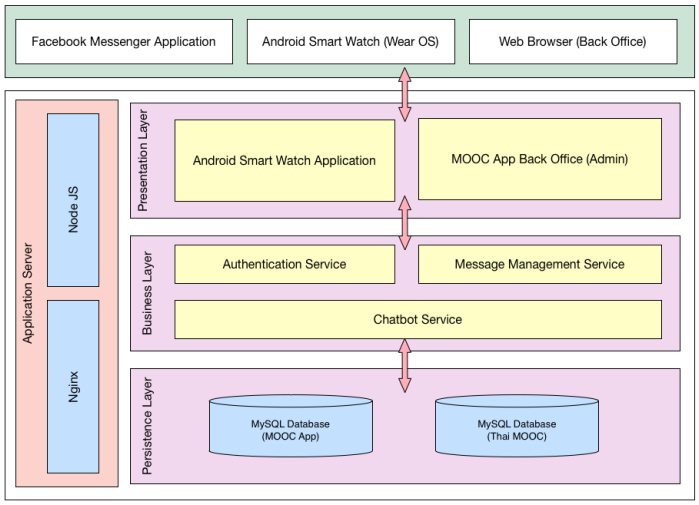

Figure 8: Logical view of the iChat smart system

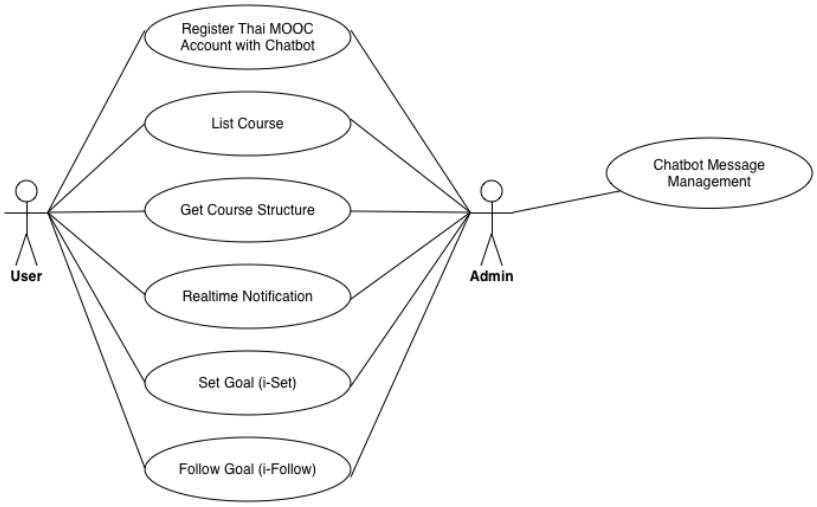

Figure 9: Use case of iChat smart system

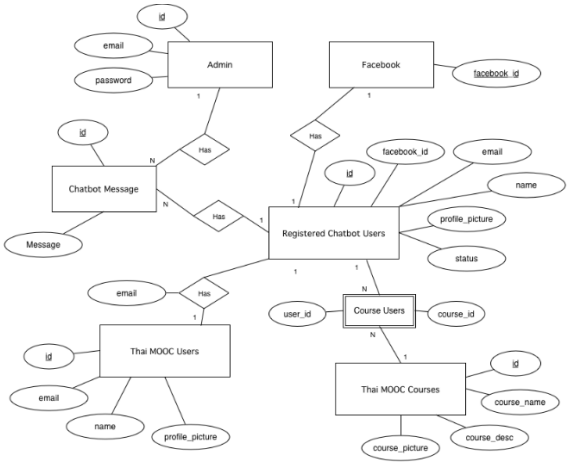

Figure 10: Data dictionary of iChat smart system

5.4 Research Question 4: To What Extent and how do Learners who Study With the GSRL System Have Different Achievement Motivation in MOOC Learning Before and After Studying

The researcher used the concept of gamification through using badges and levels to show learning progress and to create achievement motivation for learners. The researcher divided the achievement motivation into four areas, as follows: (1) inquisitiveness, (2) diligence, (3) learning creativity, and (4) enthusiasm. The results of research step 3 were used to address this question. The results for using the system according to the self-assessment of the learners are shown in Table 2.

Table 2: Using results of the system according to learners' self-assessment (N = 205)

Achievement motivation	Before studying		After studying		Analysis of differences before and after studying	
	Mean	SD	Mean	SD	t	sig
Inquiring	2.071	.667	4.563	.378	56.329	.000
	(low)		(highest)			
Diligence	1.859	.522	4.585	.463	76.576	.000
	(low)		(highest)			
Learning creativity	1.808	.573	4.644	.458	69.688	.000
	(low)		(highest)			
Enthusiasm	2.215	.556	4.532	.452	57.642	.000
	(low)		(highest)			
Overall	1.988	.470	4.581	.387	89.551	.000
	(low)		(highest)			

These results show that learning on the GSRL system produces a higher achievement motivation than that for MOOC learning. The results also showed that learners aged 20 years and older had greater achievement motivation before and after studying than those aged 18–20 years. It was also found that learners aged 20 years and older had higher achievement motivation before and after learning in all four areas than those aged 18–20 years, with statistical significance at a significance level of .05.

The analysis of learners' achievement motivation through observing their learning and working behavior, showed that learners' overall achievement motivation is high level. Learners had a high level of achievement motivation in the areas of diligence, learning creativity, and enthusiasm. Inquisitiveness was at a moderate level.

The learners who had high achievement motivation according to a self-assessment had behaviors that reflected high achievement motivation as well.

6. Conclusion and Discussion

6.1 Important Factors in the Development of the GSRL System That Affect Achievement Motivation in MOOC Learning

The researcher integrated self-regulation with the concept of gamification the in design and development of the system. Self-regulation is a learning process that enables students to make plans, monitor their progress, and adopt learning strategies that are appropriate to their needs to achieve their learning goals. There are notifications delivered via mobile devices and that link to students' social media accounts to provide convenient and quick access. The gamification concepts generally adopted in teaching and learning, such as the use of badges, activity participation, and levels are seen. Using this approach, students can come to enjoy learning and participate in activities, leading to continuous learning to enhance the achievement motivation. This is consistent with the conclusions of research (Ortega-Arranz et al., 2019) on the behavior and perceptions of students toward receiving badges in open online learning, combining the concept of gamification. The results of the study showed that the number of badges the students receive from their activities can increase students' learning engagement and motivation in their open online learning. The research uses VR in MOOC learning. The major challenges to delivering learning experiences in MOOC settings are the availability and accessibility of technologies and supportive resources. In addition, learners can control their pace of learning. The results showed that the experimental group reported statistically higher levels of motivation than the control group. Thus, immersive learning positively contributed to learners' motivation and enjoyment (Ip et al., 2019).

Ubiquitous learning is another factor that helps promote achievement motivation for learners. It enables learners to easily access learning anywhere and anytime through the use of mobile devices. In this study, a chatbot was developed and applied in the delivery of a MOOC. It acts as a personal learning assistant, allowing students and instructors instant access to information (Bii, Too, and Mukwa, 2018). It reports learning progress and provides advice and details on learners' lessons connected to the social networks that the students use. Students can connect with the chatbot via a smart watch, including the receipt of notifications on activities and receiving badges from open online learning activities. This is in accordance with the results of previous study (Buchem et al., 2015) describing the use of wearable technologies in teaching and learning to increase learning opportunities.

6.2 Design and Development of the GSRL System

Here, the researcher examined the data that were collected from learners' questionnaires. The results of the analysis of the needs of the self-regulated system and the concept of gamification in the context of ubiquitous learning were used to design a self-regulated system and enhance the achievement motivation for MOOC. An expert evaluation found that our GSRL system overall had a system design and function that was suitable, attractive, modern, easy to use, and uncomplicated. It was assessed as practical and able to help stimulate and enhance achievement motivation at the highest level. However, the experts provided additional suggestions on how to make message more concise and to enlarge font size to make it easier to read. The researchers then adjusted the text in the chatbot to make it more concise and easier to understand. In addition, the menus were designed to allow learners to easily access resources by with the use of a chatbot via a smart watch. The badges were designed to be interesting to stimulate and enhance learners' motivation. This is consistent with the findings of Aladwani (2006) and Arain et al. (2019), who studied the factors affecting higher education learners' satisfaction with online learning. The results showed that the quality of information, the quality of the system in terms of the flexibility and ease of use, and the quality of the screen design affected the satisfaction in using m-learning of students. In addition, research has investigated the 3S method, as used in learning via MOOCs on edX/open edX. The 3S applications of social, sentiments, and skills showed that it can enable instructors to understand learners' behaviors, including the increase of activity near critical dates. It also benefits teachers through increasing their awareness of problems in acquiring certain skills. In addition, this allowed the functions to be implemented regarding the participation in the course, response times, messages with more votes or responses, the sentiments that users exhibited in their posts, and the skills that produced a higher level of debate in the course (Moreno-Marcos et al., 2019).

The researcher applied self-regulation in terms of the development of the system. Self-regulation is a process where learners learn through planning, setting study goals, and monitoring their own progress to achieve objectives. This can help learners have learning discipline and become successful in MOOCs. This is consistent with the research of Min and Foon (2019), who described self-regulation as an important process for online open learners. This research divides self-regulation into three areas, consisting of behavior, emotions, and thinking processes. for the emotional responses in this study were as follows: learners were interested, enjoyed learning,

and prioritized their goals. Further, their behaviors were organized: students managed their own study time and applied the knowledge gained from MOOCs in daily life. Finally, learners developed their own learning goals and expectations for academic achievement.

6.3 Discussion of the use of the GSRL System

Data were collected from 205 students in higher education in all four regions of Thailand: north, central, northeast and south. The students were divided into two groups by age: 18–20 years and older than 20 years. The assessment results of achievement motivation according to the opinions of learners before and after studying showed that learners had higher achievement motivation after studying with the MOOC used in this study than before, in terms of diligence, learning enthusiasm, creativity for learning, and eagerness, with statistical significance at the level of .05. This shows that a self-regulated system that combines the concept of gamification can enhance learners' achievement motivation in MOOCs. This is consistent with other research, performed by Ortega-Arranz et al. (2019), which found that students had higher motivation and behavior to continue in open online learning from the use of badges. Onah et al. (2019) found that learners were more attached to digital MOOCs through the use of a self-regulated system. In addition to applying self-regulation and gamification concepts in teaching and learning, the researcher considered that the designed contents, activities, and missions, as well as the conditions for obtaining badges and levels, are also important to creating achievement motivation for students in open online learning.

Taking into account the achievement motivation assessment by age group, both in terms of the assessment based on the opinions of the learners and the observation of behavior in studying and working found that students aged 20 years and older were more motivated than those aged between 18–20 years before and after studying. This may be because older learners have greater experience and knowledge, enabling them to have different levels of motivation. Therefore, in the design MOOCs, it is important to be aware of the differences in learners, factors in continuous learning, learning engagement, and learners' achievement motivation (Lerís et al., 2016; Brooker et al., 2018).

In addition, it was found that learners in the northeast region had a much higher achievement motivation both before and after studying than those in other regions. In achievement motivation, diligence and enthusiasm showed statistically significant differences at the .05 level. It was found that the difference in learners' achievement motivation in a pre- and post-test in the areas of diligence, inquiring, and learning creativity were significant at the .05 level. Eagerness in study before and after studying were not significantly different at the .05 level, possibly because of artifacts in the students' response to the questionnaire. It was found that students had high interest in MOOCs, resulting in eagerness before and after learning. This is consistent with the findings of Lerís et al. (2016), who investigated students' personal interests of in course selection and activity participation in MOOCs. However, for the achievement motivation from observing working and studying behavior during activities by region that students in the northeast region had higher achievement motivation than those in other regions. All four regions had statistically significant differences between before and after the course at the .05 level. This may be because students were able to manage their own learning themselves using the chatbot's notifications. The learners were able to participate in activities, track their learning progress, gain level promotions levels, and obtain badges from doing activities in open online learning that is convenient, easy to access, and fast. This is consistent with the work of Onah et al. (2019), who designed MOOCs by showing the learning progress of the learners in which students can manage their own study time to promote self-regulation behavior.

Taking into account the results of achievement motivation through observing study behavior while doing activities, it was found that the overall achievement motivation of learners was at a high level. It was found that diligence, learning creativity, and enthusiasm were at a high level. Inquisitiveness was at a moderate level. This may be because the learners had different learning contexts and different amounts of time to do learning activities. This is consistent with the findings of Lan et al. 2019 and Min and Foon (2019), who found that learning behavior while doing activities, in terms of setting goals, planning studies, managing time, and reflecting on one's own activities, had an effect on MOOC learners.

The analysis of achievement motivation conducted here from response data from learners and observations of learning behavior while participating in MOOC activities showed that the average scores of all pairs were significantly related at the .05 level, indicating that where learners had high achievement motivation die to self-assessment, their behavior would also reflect high achievement motivation. The self-regulated system combined with gamification via iChat Smart, a chatbot that connects via a smart watch to the Facebook Messenger that students use in daily life, enabling students to access activity alerts and details of the courses easily, as well as

giving them the opportunity to earn badges for activities and their online learning in MOOCs. Learners were able to design their learning and manage their time freely, resulting in higher achievement motivation. Therefore, behavior in learning while participating in the online learner activities, such as involvement in activities, exchanging opinions between students and instructors, conducting self-evaluation, using a chatbot and wearable devices for learning, and performing activities to collect badges and levels are behaviors that reflect that achievement motivation also increased. This is consistent with the work by Sharma and Sharma (2018), who applied self-regulation to analyze the behavioral, emotional, and intellectual adherence of open online learning and research by Lan et al. (2019) that used gamification in MOOCs.

As the conclusion and discussion above highlighted the positive impact of combining self-regulation and gamification (iChat Smart) on achievement motivation in MOOC learning, it is necessary to emphasize this positive impact further. Additionally, the functionality of iChat Smart could be enhanced according to user needs, such as improving the current rule-based chatbot system. With recent technological advancements, the potential of this chatbot could be optimized to design more personalized learning management and interact with users as a learning assistant and in conversational forms using generative AI. Enhancing these capabilities would help engage learners and boost their achievement motivation. Furthermore, future research directions may cover adaptability to meet the needs of diverse users, support all devices, and address other relevant learning outcomes. Additionally, studying the long-term effects of using such a chatbot with the aforementioned functions would be worthwhile.

Authors' contributions

JK and PK conceptualized and designed the experiments, conducted them, analyzed and interpreted the data, contributed reagents, materials, analysis tools, or data, and wrote the paper. All authors have read and approved the final manuscript.

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Teaching Experience Differences in Social-Emotional Aspects of Emergency Remote Teaching

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Abstract: The present mixed-method research studied the perceptions of teachers following shift to emergency remote teaching (ERT). It also examined differences between more and less experienced teachers, emphasizing their subjective interpretations of personal experiences, teachers' perspectives on students, and their views on educational relationships. An online questionnaire, specifically constructed for this purpose, explored the social-emotional dimensions of the shift to ERT. The results expose a spectrum of stances and perceptions regarding the change. Overall, the participants reported that no significant change has occurred following the transition to ERT, neither in self-perception nor in the quality of their relationships with their students. However, significant differences were found between more and less experienced teachers. In adapting to the transition, less experienced teachers reported encountering greater challenges than their more seasoned colleagues. This study explores possible links between remote (or online) teaching and Social-Emotional Learning (SEL). It calls for the inclusion of social and emotional components in educational and teacher training processes. Such changes will allow better preparation and adoption of effective strategies to cope with remote-online teaching challenges.

Keywords: Covid-19, Emergency Remote Teaching (ERT), Israel, Social-Emotional Learning (SEL), Teaching experience

1. Introduction

The COVID-19 pandemic prompted an abrupt transition to remote learning, forcing teachers to promptly adapt to a new and unfamiliar educational paradigm and acquire requisite tools for emergency remote teaching. This sudden shift had diverse educational ramification, notably impacting teachers' personal experiences and teacher-student relations.

This study examined the experiences of teachers with a specific focus on changes in their perceptions of themselves and of their students following the transition to emergency remote learning. Its objective was to examine the impact of this sudden pedagogical shift on teachers' experience and to identify differences among them, based on demographic variables and professional factors. At the theoretical level, studying the effects of the transition to emergency remote teaching and the distinctions among defined groups, was to advance understanding of the complexities inherent in the change and their implications, particularly concerning personal experiences and educational relationships. On the practical level, such insights could facilitate the incorporation of appropriate educational solutions to evolving needs within teacher training programs. It may also call for necessitating adjustments in the professional development of educators to integrate remote/online pedagogy into the broader education system.

1.1 Emergency Remote Teaching

Emergency remote teaching (ERT) relates to unplanned and temporary remote teaching. It may include educational activities that would typically take place in face-to-face or hybrid formats. Thus, ERT is a distinct type of remote teaching, that should be assessed differently (Hodges et al., 2020). Some studies examined the influences of ERT on schools' teachers and curricula (Bond, 2021). Other studies focused on the implications of ERT on student experience (Tzafilkou, Perifanou, & Economides, 2021). This study examines the self-experience and interpersonal relationships of teachers in Israel throughout the transition to ERT, employing a social-emotional learning approach. The selection of this focus stems from several compelling factors, including the necessitating conditions, such as lockdowns and social distancing measures. Furthermore, the pedagogical characteristics of this period, marked by a significant reduction in interpersonal interactions among teachers and students, alongside emergent distress agents such as loneliness, anxiety, tension, and depression. These accentuated the need for attention to social-emotional aspects in the context of ERT. The analysis of social and emotional facets of teaching serves to facilitate the restructuring of the remote learning to accentuate educational relationships, thereby fostering the wellbeing and success of both teachers and students. The findings may contribute to teacher training processes, preparing prospective educators for future ERT scenarios (and remote/online teaching in general) and fostering the development of social and emotional competencies.

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1.2 Social-Emotional Learning During the COVID-19 Pandemic

Social-emotional learning (SEL) constitutes an educational approach grounded in research and practical applications, underscoring the significance of emotional, interpersonal, and social factors in fostering a successful educational process. SEL encompasses five core educational focal points: self-awareness, self-management, social awareness, social skills, and responsible decision-making, each with distinct sub-categories representing specific competencies (CASEL, 2020). The surrounding environment (or context), including the classroom, school, family, and community, is also a part of the CASEL model. The qualities of each of the circles and the way they interact is expected to influence the development of the social-emotional competencies.

At the core of SEL lies the assertion that attending to the well-being of both students and teachers is a prerequisite for holistic development, impacting various domains such as enhanced academic achievements, refined social and emotional skills, improved self-perception, favorable attitudes towards school, along with a reduction in negative behaviors, teacher stress and burnout levels (Jones, Greenberg, & Crowley, 2015). The cultivation of social and emotional skills in early education, particularly at the elementary level, has been identified as a predictor of future employment, economic and academic success, and physical health (Deming, 2017). Other studies found improvements in academic achievements (mathematics and reading), reductions in reported levels of hostility, aggression, and depression, as well as positive evaluations by teachers regarding students' academic skills and attentiveness (Durlak et al., 2011; Jones, Greenberg & Crowley, 2015). Moreover, SEL has been linked to the narrowing of academic and social disparities (Borman et al., 2016; Allbright et al., 2019). Intervention programs have shown particular efficacy for students identified as at-risk or experiencing behavioral challenges, narrowing down their academic lacunae (Jones, Brown, & Aber, 2011). Numerous studies and meta-analyses (e.g., Durlak et al., 2011; Wigelsworth et al., 2016) have substantiated enhancements across these domains.

1.3 ERT, SEL and Teaching Experience

The transition to ERT has prompted educators and education researchers to investigate factors conducive to the creation of favorable Social-Emotional SEL conditions. Among these factors, the necessity for a sense of belonging and connection to a group (class or school) has emerged as a crucial element to counterbalance the challenges of social distancing and loneliness (Arslan, 2021). It is asserted that establishing quality educational connections and a sense of care contribute to students' feelings of safety and foster academic, emotional, and behavioral growth, particularly during ERT (Minahan, 2020). Recognizing the pivotal role of educators' wellbeing throughout the pandemic, Dabrowsky (2020) emphasized its influence on teacher satisfaction and productivity, on students' wellbeing and achievements. She advocates for prioritizing relationships and human connections at the core of educational practices, even preceding pedagogy.

A comprehensive literature review conducted during the pandemic (Hehir et al., 2021) identified five central contributors to the enhancement of belongingness and connectedness in remote learning conditions. Notably, teacher-student interaction, encompassing teacher presence, familiarity, and active involvement in learning processes, emerged as a significant factor. teacher-student interaction was found to influence student interaction and engagement with the educational material (Mandernach, Robertson & Steele, 2018). These relationships are inherently shaped by teacher characteristics, including individual personality characteristics, alongside demographic and professional variables.

This study aims to investigate the impact of demographic and professional variables in general and teaching experience in particular, on the quality of teacher-student connections under ERT conditions. Previous studies (e.g., Alea et al., 2020; Dewaele et al., 2018) have shown that experienced teachers faced less difficulty than novices beginning their professional track. This agrees with the commonsense assumption that experience is conducive to self-assurance while professional instability exacerbates stress and mental distress (Ozamiz-Etxebarria et al., 2021). At the same time, other findings indicate that less experienced (or younger) teachers have the advantage of mastering the information and communication technologies (Šabić, Baranović & Rogošić, 2021; Portillo, Garay, Tejada, & Bilbao, 2020). The underlying assumption was that gaining an understanding of these factors would influence teachers' self-perception and their perception of students, can unveil specific difficulties and contribute to identifying appropriate solutions. Hence, fostering the creation of a socially and emotionally secure learning environment for remote education. The voices of teachers are particularly significant in this context, being in the frontline of the switch to ERT and thus firsthand experiencing its challenges. Understanding their experiences will facilitate the development of theoretical and practical approaches to remote teaching and learning, emphasizing its social and emotional aspects which are not sufficiently emphasized in the relevant professional literature.

1.4 Research Questions

The aim of this study is to investigate: (1) How teachers perceive and evaluate the implications of the transition to ERT, (2) Examining differences between more and less experienced teachers in the ways they experience themselves and their students.

2. Method

This is a mixed-method study, employing both quantitative and qualitative methodologies. As such it provided diverse data on the subject under investigation (Mertens, 2019).

Participants: The study comprised 154 teachers within the Israeli education system, ranging in age from 28 to 71 years (M=44.7, SD=9.25). The participants had an average teaching experience of 13 years (SD=0.72), with a range spanning from one to forty years. Approximately 60% of the teachers were engaged in primary school teaching, while the remaining participants were involved in post-primary school teaching.

2.1 Research Tools

An online self-report questionnaire, encompassing both closed and open-ended questions, was disseminated to the participants. The questionnaire comprised two sections outlined below. The first section featured six closed statements consisted of six closed statements concerning the transition to ERT. The statements addressed the impact of the switch on the teachers' self-experience and their relations with their students. All statements underwent refinement following expert validation. Responses were assessed on a Likert scale, where 1 denoted complete disagreement and 5 signified complete agreement. Subsequently, participants were encouraged to articulate, in their own words, how they experienced the switch to ERT, their insights or any other addition. In the second section of the questionnaire participants were asked to provide demographic and professional details, including age, gender, education, years of experience, and weekly teaching hours. The online questionnaire was distributed through various channels, including social networks—primarily Facebook—via colleagues and acquaintances engaged in education (on WhatsApp), and in M.A. and teaching specialization classrooms.

Ethics: The questionnaires were anonymous. The acquired data served exclusively for research purposes. The College ethics committee approved the research (3_2020AVI, 21/10/2020). This research received no external funding. The author declares no competing interests. Data and materials are available from the corresponding author on reasonable request.

Data analysis: The qualitative data analysis used descriptive statistic indices (central tendency and dispersion) and inferential methods, including ANOVA and T-test. Primary (open) coding, allowing the categorization of content and views (Straus & Corbin, 1990), Served to categorize the qualitative data by content. The analysis revealed five nominal categories (see below), each representing a basic view about the switch to ERT.

3. Findings

Initially, the *quantitative* findings of the teachers' evaluation of the switch to ERT (the first research question) will be presented. The participants highly agreed with the fourth statement, relating to the increased the students' self-learning. A middle rating was given by the participants to the sixth statement referring to partnership and equality between students and teachers and to the second statement regarding a decline in the way the teachers experienced their students following the switch to remote learning. The first and the fifth statements received a low rating. The participants disagreed with the claims that the crisis caused by switching to ERT worsened their personal experience as teachers or lessened discipline and authority. Table 1 displays the averages and SDs of the participants' agreement with each of the statements.

Table 1: Participants' remote teaching experience: Averages and standard deviations (N=154)

Statement	Average	SD
(1) The switch to remote teaching negatively affected my teaching experience	2.53	1.12
(2) The switch to remote teaching negatively affected my relations with the students	3.00	1.11
(3) The switch to remote teaching increased the behavioral challenges I encounter in my work	2.71	1.21
(4) The switch to remote teaching increased my students' self-learning	3.87	0.99
(5) The switch to remote teaching emphasized elements of authority and discipline in my teaching	2.51	1.01
(6) The switch to remote teaching emphasized elements of equality and cooperation between me and my students	3.21	1.05

Teaching experience differences (research question 2) were examined next. The participants were divided into three groups: (1) 0-5 years of experience; (2) 6-15 years of experience; (3) Over 16 years of experience. A one-way analysis of variance (ANOVA) yielded the findings presented in Table 2. They indicate significant differences between the three teachers' groups following the switch to remote learning concerning personal experience, experience with the students, and changes in self-learning. The experiences of younger teachers emerged as worse than those of the more experienced ones, and the reported difference became smaller with experience. The more experienced teachers agreed more than their younger colleagues with the statement that the switch to remote learning strengthened the students' self-learning elements.

Table 2: Participants' experience of the switch to remote learning by teaching years (N=154): Averages and standard deviations

Statement		Teaching experience			
		Up to 5 years	**6-15 years**	**Over 16 years**	**F**
1. The switch worsened my teaching experience	Average	2.97	2.56	2.25	4.08*
	SD	(1.13)	(1.11)	(1.08)	
2. The switch damaged my experience with the students	Average	3.43	3.07	2.65	5.19**
	SD	(1.01)	(1.03)	(1.20)	
3. The switch increased the behavioral challenges I encounter in my work	Average	2.97	2.69	2.60	.90
	SD	(1.35)	(1.15)	(1.23)	
4. The switch increased my students' self-learning	Average	3.47	3.89	4.08	3.73*
	SD	(1.22	(.90)	(.93)	
5. Following the switch elements of authority and discipline were emphasized in my teaching	Average	2.53	2.53	2.46	.08
	SD	(1.04)	(.84)	(1.23)	
6. Following the switch elements of elements of equality and collaboration were emphasized in my teaching	Average	3.27	3.18	3.21	.07
	SD	(1.14)	(.89)	(1.21)	
N		30	72	52	

Lastly, a two-way analysis of variance did not yield a statistically significant interaction effect.

55 descriptive replies were provided and analyzed *qualitatively* (content analysis). Five major categories were identified, representing five different reactions and stands towards the switch. Each of them emphasizes a specific quality of personal experience or interpersonal relations. Together, they shed light on various aspects of SEL during the ERT period. The five categories and their frequencies are presented below, in figure 1.

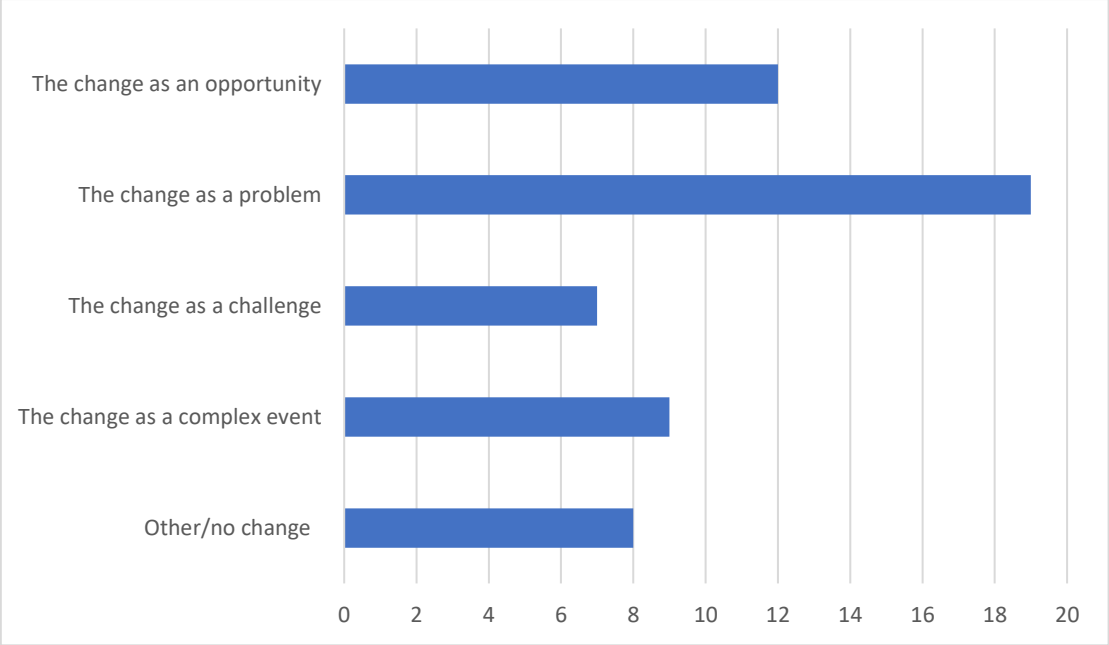

Figure 1: Incidence of the descriptive reactions by categories

As shown, the participants tended to view the switch to ERT in an unfavorable way, as an unwelcome change. Many of them emphasized that it was challenging or raised new complexities. Such responses stress the perceived effort and load the teachers experienced. Examples of descriptive replies in each of the categories are presented below.

The change as an opportunity: These replies indicated that the change was viewed as an opportunity to improve processes: "Developing the students' self-management skills, enhancing the students' research skills, more flexible thinking in teachers, teachers and students step out of their comfort zones." Many participants felt that the shift strengthened their connection with their students and their families: "the closer connection with the families during this period increased my cooperation with the parents and the students." Thus, the shift contributed to a sense of cooperation and reciprocal relationships with the students, or "Greater mutual closeness." Since this category received a relatively high number of reactions, one can assume that it reflects a relatively common stand towards remote teaching, viewing is as an opportunity.

The change as a problem: Here, expressions of concern for both the students' and the teachers' wellbeing were stressed: "Acute damage to children whose home is unstable and non-supportive. The teacher is helpless." Some reactions expressed emotional distress following the shift: "The distance from the class, the same beat, warmness, and activity often fill me with despair. My self-value has decreased." Such reactions express the perceived challenges educators had to cope with, initially without a satisfactory response. The described difficulties stemmed from the gap between the teachers' needs and expectations and actual reality. As mentioned, this category received the highest number of reactions, expressing the widespread difficulty many teachers experienced following the shift.

The change as a challenge: Here, the respondents saw the switch as an opportunity for a wider personal, pedagogical, or educational change. Therefore, the dominant stance here tended to be more involved and motivated: "Remote learning is definitely challenging. First, it is different, and one must learn how to negotiate this ground. The children must learn this, and so must I […] It is possible to create a good and protective atmosphere, consolidate the class, and advance the students even from a distance." Some participants emphasized the social aspects of the change and the ways it impacted interpersonal relations: "It is more difficult to create a personal relationship with them, but once this is achieved, it is better." Other comments focused on pedagogical challenges: "It requires diversifying the teaching methods. It requires being attentive to the students […] It requires developing tools to understand where a student has difficulty and come up with solutions to narrow the gap." The relatively small number of reactions to this category may indicate a more general difficulty to maintain a complex view of the situation (of sudden and undesirable change).

The change as a complex event: A complex perception of the situation allowed for important distinctions to be identified and dealt with: "The class is divided. Some students really enjoy remote learning, manage their time well, can study independently, and make good progress. Other students need to regain their previous routine. They are unable to concentrate in remote circumstances and are lost." Other participants focus on gaps in students' self-learning capabilities: "strong students who have already developed independent learning skills enjoy their benefits and adapt well to remote learning. Weaker students enter the online lesson to show they are present and then go on sleeping or doing things other than learning. Average students sometimes also tend to slack in remote learning." Some comments stressed that such gaps parallel socioeconomic disparities affecting students' and teachers' wellbeing. The comments in this category stress the need to train teachers for differential teaching and develop their personalize education abilities. This will help narrow the widening educational gaps in ERT.

4. Discussion

The analysis of the qualitative research components concerning consequent changes to the switch to ERT showed that no damage was caused to the teachers' self-perception. Further, the teachers did not exercise more authoritarian discipline towards their students. Indeed, many of them felt that relationships became closer and more reciprocal. However, the switch to ERT seem to increase the need for students' self-learning. Some of them were negatively affects the changing learning conditions. Consequently, their achievements dropped comparing to their peers who had more resources and better support at home. Consequently, teachers sensed that educational gaps were broadening following the switch. Research confirms that such gap broadening has indeed happened (Engzell, Frey & Varhagen, 2020; Blundell et al., 2020). Preparing teachers for similar future changes, may create better conditions for all teachers and students to succeed. That is, for equal opportunities and narrowing educational gaps. For this to happen, teacher training programs need to incorporate in their curricula specific components dedicated to developing students' self-regulated learning skills (Carter Jr et al., 2020). Such training may also cover differential teaching and individual tutoring (Tsilitsky et al., 2020). In any case, SEL skills would allow teachers and student teachers to successfully cope with the unique challenges of remote teaching.

Another noteworthy finding regards the significant differences in the self-perception and the perception of students between novice and experienced teachers. Novice teachers reported a more significant change to the worse in these aspects than experienced ones. Their perception of themselves and their students tended to be negative. They struggled to see the switch as an opportunity for development and contended with significant difficulties. To improve their coping with emergency and routine disruptions while maintaining a sense of self-efficacy, their training should attend to and offer an appropriate response for these points.

The qualitative analysis highlight some of the risks teachers encountered as well as the opportunities the identified in the new and unexpected situation. A substantial number of comments conveyed a perception that the transition to ERT represented a deleterious shift, constituting the most prevalent category with 19 comments. Additionally, a noteworthy portion of the statements addressed the challenge of adapting to the change, as evidenced by seven comments, and struggling with the intricacies of the novel situation, as indicated by nine comments. A discernible disparity emerged between "the change as a problem" category, characterized by expressions of distress, frustration, and a sense of external locus of control, and the other two categories – "the change as a challenge" and "the change as a complex event" (eight comments each), which manifested a heightened capacity and confidence. Nevertheless, the comments encompassing these three categories collectively constituted an overwhelming majority, signifying some degree of unsatisfied need or distress. Arguably, the difficulty might have originated, in part, from the agile and unpredictable changes during this period, vis-à-vis the expectations, skills, and work patterns of the teachers. Bridging this gap could be facilitated through teacher training and professional development processes.

The findings substantiate the proposition that a primary impediment in transitioning to ERT lay in the social-emotional domain. This requires an adaptation to the changing reality as well as a flexible approach towards existing instructional paradigms. At a theoretical level, these findings underscore the interconnectedness of remote teaching and SEL. Contrary to common perception, which often construes these terms as representing two divergent educational approaches, they synergistically complement each other in this context. Consequently, it is necessary to incorporate social and emotional components within the framework of remote learning processes to enhance their efficacy. This integration should be embedded in teacher training programs, throughout the duration of teachers' professional development, and, notably, in the pedagogical engagement with students. The absence of these components is expected to lead to an escalation of difficulties during ERT and remote teaching in general. This process exhibits a reciprocal nature, as online tools can potentially foster

the social-emotional dimensions of both educators and learners. This conclusion is supported, in part, by the analysis of the verbal comments emphasizing the positive aspects of the switch. According to this perspective, online teaching and learning embody new opportunities, particularly comparing to traditional teaching, learning, and evaluation approaches. It is responsive to diversity, fostering better conditions for the wellbeing and success of a diverse array of students and educators. Subsequent research endeavors could elucidate the interrelations between remote teaching and SEL and contribute to the formulation of an integrative theory for both domainsWhile the quantitative components facilitated the identification of broad trends, they fell short in enabling more nuanced observations that could carry substantive implications. Simultaneously, the qualitative elements offered a preliminary insight into the personal experiences of participants; however, they did not afford an in-depth exploration of these experiences. The incorporation of in-depth interviews holds promise for unveiling a more detailed and comprehensive experiential spectrum.

5. Conclusions

Differences in the teaching experience variable, as substantiated by participants' free-style comments, affirm the notion that teachers' challenges encompass both personal (emotional) and interpersonal (social) dimensions. It is imperative for teacher training programs to address these challenges, which have become more pronounced with the outbreak of the COVID-19 pandemic but are not exclusive to this period. With the growing and widespread use of distant learning, it is imperative to train teachers to navigate intricate personal and interpersonal situations, while cultivating essential skills such as emotional management, empathy, and responsible decision-making. Integrating these fundamental aspects of SEL into teacher training can enhance teaching-learning-evaluation processes, particularly within the realm of online learning, in a constantly changing reality. Emphasizing these components in teacher training stands to enhance the wellbeing of both educators and students, thereby improving the overall educational climate. In an era marked by uncertainty and ambiguity, the reciprocal influences of personal experiences and interpersonal relations assume great significance. Strengthening these elements would empower educators to facilitate stable and self-assured teaching in uncertain and unpredictable conditions. This, in turn, can inspire the cultivation of similar capacities in students through modeling and direct learning of social-emotional skills by their teachers.

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Integration of ICT in Schools: Context-Aware ICT Appropriation (CAIA) Model

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Abstract: The integration of Information and Communication Technology (ICT) into South African schools is problematic due to access inequalities. This study investigated the dynamics of access to and use of ICT in the context of the COVID-19 pandemic. The qualitative study used a phenomenological approach based on a posthuman philosophical framework and used the Actor-network theory (ANT) as a methodological approach to educational technology. Van Dijk's cumulative access model, combined with Jansen's dimensions of digital inequality, was employed as a theoretical and conceptual framework. ANT was used to identify the various actors involved in the process, to examine their interactions, to understand the use of technology, and to assess their integration into educational practices. The study confirms that access does not follow a simplistic linear progression of continuous phases and proposes the *Context-Aware ICT Appropriation* (CAIA) model that encompasses a broader contextual approach. This research supports the need for a more complex and nuanced understanding of the multifaceted concept of access to ICT, which more accurately reflects how teachers actively interact with technology in an increasingly technology-driven society. The study has contributed to the theoretical and practical aspects of the field and laid the foundations for future research. It is essential to assess the practical effectiveness and capacity of the CAIA model to overcome the limitations of isolated technology interventions. The researcher advocates for future studies to evaluate the applicability and efficacy of the proposed CAIA model in the real world.

Keywords: Information and communication technology (ICT), ICT access, ICT readiness, ICT integration

1. Introduction

Integration of Information and Communication Technology (ICT) in South African schools is problematic due to inequalities in access to ICT. This study explored access to and use of ICT in the context of the COVID-19 pandemic. Although the literature review highlighted an urgent need for improved access to ICT, there is a notable gap in research that sheds light on the complexities of access to ICT and how it can support or hinder the use of ICT for educational purposes. To address this research gap, this study sought to develop a sound theoretical understanding of the dynamics behind access to and use of ICT in schools.

This qualitative study employed a phenomenological approach guided by a posthumanist philosophical framework to explore the interplay between access to and use of ICT. Actor-network theory (ANT) was used as a methodological approach and Van Dijk's cumulative model of access, combined with Jansen's dimensions of digital inequality, was used as the theoretical and conceptual framework.

The findings of this study challenge the notion that access to ICT follows a linear path toward usage. Instead, successful integration of ICT requires a more networked and relational perspective on access, highlighting the significance of contexts that require, motivate and empower teachers to use ICT. To this end, the study introduces an original contribution to the existing body of knowledge - the Context-Aware ICT Appropriation (CAIA) model.

2. Problem Statement

The current body of literature lacks a comprehensive grasp of teachers' access to and use of ICT (Soomro et al., 2018). While inequalities in access to and use of ICT are an area of concern, theoretical attempts to understand the dynamics shaping these inequalities are scarce (Ghobadi and Ghobadi, 2015). In South Africa, empirical data are scarce regarding access to and use of ICT in schools, particularly from the viewpoint of teachers (Mwapwele et al., 2019).

Variations in socio-economic, geographical, and educational contexts significantly affect access to and use of ICT for educational purposes in South Africa. This reality posed a formidable challenge to the delivery of education during the COVID-19 pandemic (Padmanabhanunni and Pretorius, 2023). As a result, only a small number of

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well-resourced schools transitioned to technology-mediated remote teaching, while most schools experienced little to no educational activity (Dube, 2020). Considering the persisting disparities in ICT access within the South African education system, a focus on ensuring equitable and sustainable access is both justifiable and necessary (Czerniewicz and Brown, 2005).

3. Literature Review

A critical examination of the current body of knowledge on the topic serves as the cornerstone for the study. The literature review homes in on principal themes and interrelated subtopics within the research field and constructs a theoretical and conceptual framework for the study.

3.1 COVID-19 Pandemic: Educational Disruption and Response

The global COVID-19 pandemic represented the most extensive disruption to education ever (Santandreu Calonge et al., 2022; Dorfsman and Horenczyk, 2022; Crompton et al., 2021). While the pandemic halted traditional classroom-based education, 21st-century technology provided a substantive way for schools to remain operational (Arnett, 2021; Fuchs, 2022). Because of the swift implementation of technology, the term *emergency remote teaching* (ERT) emerged to describe and reflect the urgency of surviving in a time of crisis (Hodges, Moore and Lockee, 2020; Bozkurt and Sharma, 2020).

The South African government implemented various measures to ensure the continuity of teaching and learning during the pandemic. The success of these initiatives was, however, significantly shaped by the diverse socio-economic, geographical, and educational contexts existing throughout the country. For example, many government schools are located in underserved communities and have limited access to technology and the internet. Private schools, on the other hand, generally have more resources and better technological infrastructure and were able to adapt to online learning more smoothly. However, the accessibility of private schools is limited to those who can afford tuition, creating disparities in educational access. Schools located in more affluent communities often had greater financial resources, which allowed them to invest in technology, infrastructure, and additional support for students.

Learners in poor communities lacked access to technology and educational resources which made it difficult for them to keep up with their studies during lockdowns. Urban schools in South Africa's major cities often had better access to technology and internet connectivity, while geographically isolated rural schools often had limited access to the internet, electricity, and technology devices. In the best-case scenario, a very small number of well-resourced schools managed to transition smoothly to remote teaching (Dube, 2020; Landa, Zhou and Marongwe, 2021; Mbhiza, 2021). In the worst-case situations, however, teaching and learning essentially came to a standstill due to the absence of the necessary digital infrastructure (Lie et al., 2020; Hennessy et al., 2021; Moyo et al., 2022), placing numerous students at risk of falling behind (Dube, 2020).

3.2 ICT Access

While ICT enables remote teaching and learning capabilities (Tauson and Stannard, 2018), technology-mediated teaching is only viable in educational settings where there is appropriate access to ICT (Padmanabhanunni and Pretorius, 2023). Given the skewed access to resources and the fundamental inequalities that continue to characterise South African society, a focus on ICT access is understandable.

3.2.1 Access and use

Access to and use of ICT are interdependent constructs. ICT only has meaning or value in relation to an implicit or explicit purpose (Sadeck, Chigona and Cronjé, 2020). In the context of education, access thus refers to teachers' willingness, ability, and need to actually use ICT for educational purposes (Czerniewicz and Brown, 2005).

3.2.2 Theories of access

The concept and theories of access to ICT have in recent years evolved beyond a focus on primarily physical access. Researchers have started considering the conditions or criteria for access and broadened the concept by including additional dimensions, components, and resources (Czerniewicz and Brown, 2005).

The following models and frameworks, summarised in Table 1, offer more nuanced perspectives on the dimensions of access to ICT:

- Van Dijk (2005), focusing on exclusion, argues that unequal access to ICT perpetuates existing social inequalities and leads to further marginalization of groups;
- Bridges (2001), on the other hand, contends that access to ICT can promote social inclusion by providing opportunities for participation and engagement in society;
- Kvasny and Truex's (2001) critical theory framework scrutinizes the power structures, ideologies, and systemic inequalities that shape ICT access and use;
- Warschauer's (2003) digital divide theory explores the disparities in access to and use of ICT, particularly between different socio-economic groups and regions.

Table 1: Theories of ICT access

Van Dijk (2005) **Social Exclusion Theory**	**Bridges (2001)** **Social Inclusion Framework**	**Kvasny and Truex (2001)** **Critical Theory Framework**	**Warschauer (2003)** **Digital Divide Theory**
Emphasizes the importance of addressing not just physical access to technology but also the skills and resources necessary to utilize it effectively.	Highlights the potential of ICT to empower marginalized groups and foster social cohesion by facilitating communication, collaboration, and access to information.	Critique dominant discourses surrounding technology and argue for a deeper understanding of how power dynamics influence access to and use of ICT.	Emphasizes the need for policies and interventions to bridge the digital divide, addressing issues such as infrastructure, affordability, and digital literacy.
Dimensions of Access			
Mental access - motivation to use ICT. Physical access - ICT infrastructure and devices. Skills access - knowledge and competencies to use ICT. Usage access – purposeful use of ICT, e.g. education.	Participation - engaging in activities facilitated by ICT, e.g. communication. Engagement - Involvement in online communities and social networks. Equity - fair and equal access to and benefit from ICT. Integration - incorporation of ICT, e.g. education. Community development - fostering social cohesion, community empowerment, and collective action.	Power dynamics - distribution of power, influence, and control within the context of ICT access. Ideological constructs - dominant ideologies and discourses surrounding technology. Structural inequalities - systemic barriers and inequalities that limit access to ICT. Resistance and agency - oppressive structures and the potential for marginalized groups to assert their agency.	Global disparities - differences in ICT access and usage between countries and regions. Socioeconomic disparities - inequalities in ICT access within societies. Cultural and linguistic factors - influence of cultural values, language barriers, and digital content availability. Policy and intervention - government policies, programmes, and interventions.
Comments			
Conventional hierarchical or linear view of access and the limited focus on human agency is a concern.	Too focused at the macro level and does not consider the specifics of human agency and aspects of individual access.	Suggestion that key concepts should be 'cross-mapped' informs a more relational approach.	The four categories for social inclusion – physical, digital, human and social – offer an excellent underpinning.

While Van Dijk's model has been instrumental in exploring and understanding the complexities of ICT access, alternative theories of access to ICT have emerged, challenging the conventional hierarchical view of access. While these theories acknowledge that material access is a primary requirement, they view the appropriation of ICT as a complex and iterative process, encompassing multiple dimensions of access experienced simultaneously. Because none of these models encompass the range of resources required for access to ICT in an educational context, Czerniewicz and Brown (2005) combined, simplified and enhanced the existing models to develop a more comprehensive framework for ICT access. This model of access, illustrated in Figure 1, describes what people use, need and draw on in order to gain access to specific ICT uses in terms of four kinds of resources namely technology, personal agency, contextual and online content.

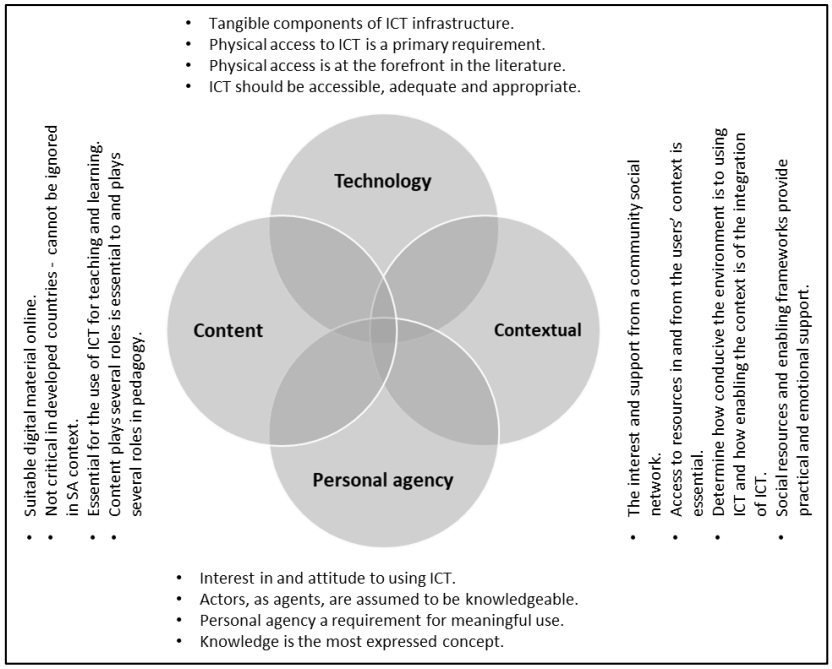

Figure 1: Access to ICT as interrelated resources (Adapted from Czerniewicz and Brown, 2005)

3.3 ICT Integration

ICT integration in education is a complex process, culminating in the actual use of ICT to enhance the teaching and learning experience (Sadeck, Chigona and Cronjé, 2020). ICT integration is discussed in more detail with reference to the TPACK model and ICT readiness.

3.3.1 TPACK

The TPACK (Technological Pedagogical Content Knowledge) framework (Mishra and Koehler, 2006) outlines the various forms of knowledge that teachers need to successfully integrate technology into their teaching practices. The most well-known aspect of this framework is its TPACK diagram, which illustrates three interconnected circles representing Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK).

This well-established framework has recently been enhanced by introducing a fourth knowledge domain, with the outer dotted circle now labelled Contextual Knowledge (XK). As depicted in Figure 2 (Mishra, 2019), Contextual Knowledge pertains to a teacher's understanding and awareness of available technology as well as the broader context within which they operate, such as the school, district, provincial, or national level.

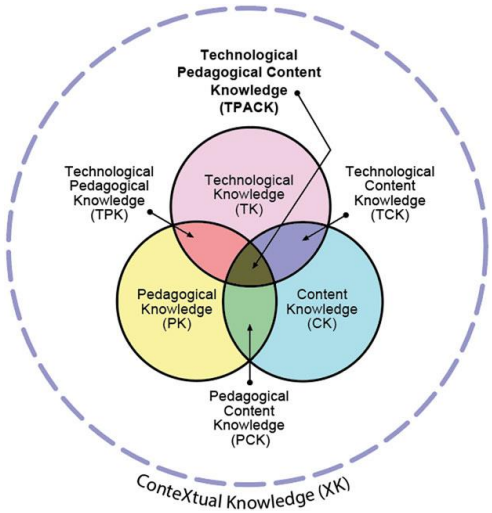

Figure 2: Revised version of the TPACK (Mishra, 2019) (Reproduced by permission of the publisher, © 2012 by tpack.org)

The adapted framework highlights the critical importance of organisational, situational, and broader contextual constraints. The success of teachers' ICT integration efforts depends not as much on their technological, pedagogical, and content knowledge, but rather on their knowledge of the context (Mishra, 2019).

3.3.2 ICT readiness

ICT readiness or digital maturity is a multifaceted concept denoting a school's capacity to successfully integrate ICT in teaching and learning (Veldsman, van Greunen and Botha, 2020). The concept is becoming more and more significant within the educational system, due to the increasing importance of ICT (Van Greunen, Kativu and Veldsman, 2021). In practice, digital maturity levels encompass a spectrum, ranging from having no access to ICT to being technologically, psychologically and pedagogically ready to conduct digital teaching and learning.

The Department of Science and Innovation (DSI) recently developed a decision support tool that can be used to assess schools' e-readiness levels before any ICT-based intervention is deployed (Van Greunen, Kativu and Veldsman, 2021). This tool evaluates e-readiness using indicators organised in five areas and five levels of maturity (Table 2).

Table 2: Digital maturity tool for schools (Van Greunen, Kativu and Veldsman, 2021)

Assessment area	Level 1 Digitally unaware	Level 2 Digital beginner	Level 3 Digitally competent	Level 4 Digitally advanced	Level 5 Digitally mature
Leadership and vision	Limited, if any awareness of using ICT in teaching practices.	Some awareness of using ICT in teaching, but not yet in practice.	Use ICT in teaching practices.	ICT integrated into teaching practices.	ICT systems integrated to strategically position the school.
ICT in the curriculum	ICT is used only in some classrooms.	Limited staff use ICT in teaching and learning.	Staff develop their digital competencies and digital content.	Staff develop their own content and use ICT for advanced teaching styles.	ICT is used extensively in teaching and learning.
Development of digital competencies		ICT in some classrooms.	. ICT in most classrooms.	ICT in most classrooms.	Digital content repository.
School ICT culture					Access via own devices in all classrooms.
School and ICT infrastructure					

The DSI tasked the Nelson Mandela University's Centre for Community Technologies (CCT) in South Africa with the refinement, testing, and enhancement of the manual tool into a digital e-Readiness Tool (Van Greunen, Kativu and Veldsman, 2021). Based on the averages the majority of schools ended up at Level 3 which indicates an awareness of the role of digital technologies (Figure 3).

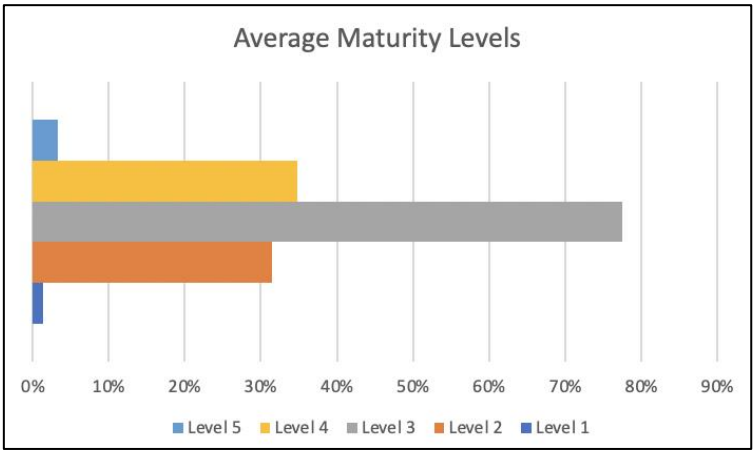

Figure 3: Average maturity levels across 5199 schools

To improve the integration of digital technologies into the education sector requires new and improved ways of doing things.

3.4 Theoretical and Conceptual Framework

Van Dijk's cumulative model of access in conjunction with Jansen's dimensions of digital inequality offered a valuable conceptual framework (Figure 4) for exploring the dimensions and dynamics of access to ICT in the South African educational context.

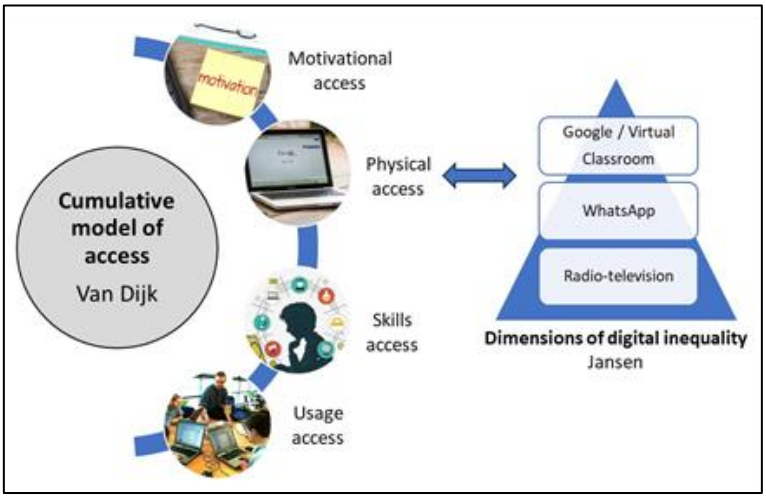

Figure 4: Theoretical and Conceptual framework (Author's construct)

Van Dijk delineates four access types, namely motivational, physical, skills and usage access, that occur in sequential stages each reliant on the others. This will lead to skills access and only then is access to full usage obtained.

1. Motivational access

Motivational access refers to the preparedness and eagerness to acquire and engage with digital technology. Despite its pivotal significance, motivation is often neglected or underestimated in real-world applications (Van Dijk 2012). Motivation can be classified into two categories: intrinsic motivation, which originates from within, and extrinsic motivation, which is externally driven (Soomro et al., 2018).

2. Physical access

Physical access, i.e. the presence of the necessary devices and resources, serves as a fundamental requirement. As a result, physical access is a significant focal point in all conversations regarding access, as indicated in the current literature (Peters et al., 2020; Crompton et al., 2021).

Jansen (2020) identified three dimensions of digital inequality (Figure 4) associated with physical or material access during the COVID-19 pandemic, namely:

- Google Classroom,
- WhatsApp, and
- Radio-Television groups.

The shift from in-person to online remote teaching was a relatively seamless process for the small number of well-equipped Google Classroom or "Virtual Classroom" (to include the use of alternative communication platforms such as Moodle and Microsoft Teams) schools. Regrettably only about 6% of all learners engaged in online remote learning during the pandemic (StatsSA, 2020). In practice, most teachers and learners made use of WhatsApp for educational communication. This preference was primarily due to a higher percentage of households using mobile phones to access the internet compared to other devices. Although WhatsApp enabled teachers and learners to engage in remote communication, the platform's educational functionality remained rudimentary, and the learning experience was adversely affected by challenges related to device availability, data costs, and inconsistent internet connections. Unfortunately, most South African learners had no alternative but to depend on educational radio and TV broadcasts for their remote learning needs. Because of the

constraints of these broadcast platforms, the lockdown resulted in minimal, if any, educational advantages for most of these learners.

3. Skills access

Skills access refers to the ability to use digital technology and consists of three levels, namely operational, informational, and strategic skills (Van Dijk, 2005). In brief, operational ICT skills are the foundational skills required for routine day-to-day use of digital tools and software applications. Informational ICT skills are the higher levels of competency in managing and manipulating digital information. Strategic ICT skills represent the highest level of digital competence and involve understanding the broader impact of technology on an organization or society and aligning technology with long-term goals and objectives.

4. Usage access

Usage access to ICT denotes the ability and opportunity to effectively employ ICT tools and resources across various domains like education, business, or personal use. It signifies the deliberate decision to engage with digital technology and assumes that individuals exercise this choice freely, influenced by factors such as need, opportunity, responsibility, availability, or effort.

Within an educational context, having usage access to ICT empowers teachers to integrate technology into their teaching practices, leading to improved teaching and learning experiences. It equips teachers with the capacity to use multimedia materials, interactive learning platforms, educational applications, and online resources to present information in engaging and interactive formats.

3.5 Critical Reflection

The relationship between access to and use of ICT in an educational context is more complex than presumed (Soomro et al., 2018). Physical access may serve as a fundamental requirement, but it does not by default lead to the actual use (Chisango, 2021). ICT integration in educational settings rather represents a multifaceted process that necessitates a more interconnected, relational, and contextualised perspective of access to and use of ICT.

4. Research Design and Method

This paper follows and expands on a study reported in an earlier paper: 'The Dynamics of Access to ICT and Technology Practices of Secondary School Teachers' (Kennedy and Cronjé, 2023). This study applied a phenomenological orientation, underpinned by an interpretivist philosophy and ANT (Tatnall, 2019; Rowan and Bigum, 2003), to explore the patterns of technology-mediated interaction between teachers and learners. An interpretative phenomenological approach was deemed appropriate as it allows the researcher to get a thorough understanding of the phenomenon by exploring the lived experiences and perceptions of participants (Cohen, Manion and Morrison., 2007; Pietkiewicz and Smith, 2012). ANT was applied as a theoretical lens as it emphasizes the agency of both human (teachers and learners) and non-human actors (technology) in the process of ICT appropriation.

The exploratory study adopted a qualitative survey design to investigate teaching with technology practices before, during, and after the COVID-19 pandemic. An online survey, created using Google Forms, was used to explore secondary school teachers' lived experiences during the COVID-19 pandemic. The survey consisted of six demographic questions, twelve open-ended questions, ten Likert-scale items, one select-all-that-apply item, and three multiple-choice items. A 4-point scale was used for the Likert-scale items (0=Low to 3=High). In terms of the content of the survey, the questions focused on teachers' experience of the transition to ERT, technological-pedagogical knowledge, and access to and use of ICT in their teaching practice. The survey included a consent statement, and responses were submitted anonymously.

Purposive sampling enabled the researcher to carefully select specific participants known for their use of educational technology and their potential to offer valuable and dependable data (Saunders, Lewis and Thornhill., 2012; Moser and Korstjens, 2018; Taherdoost, 2016). A total of 22 teachers from government schools responded to the survey. The sample was diverse in terms of gender, age, years of experience of the teachers, and socio-economic status of the schools.

This design and method allowed the researcher to gain insight into a complex phenomenon by revealing concealed experiences within a specific social setting (Merriam, 1998; Denzin and Lincoln, 2011; Creswell and Creswell, 2018). The researcher applied inductive reasoning to search for causal patterns and develop explanations for those patterns (Maxwell 2008).

4.1 Posthumanism

The term "post-human" denotes an understanding of the interrelationship between humans and their technological surroundings, along with the ethical considerations that accompany it (Wolhuter and Jacobs, 2021). Posthumanism introduces fresh perspectives on perceiving humans, including teachers and learners, as not uniquely significant but interwoven with technology. Employing a post-humanist perspective in education prompts us to reevaluate teaching methods, the generation of knowledge, and its distribution, consequently introducing innovative teaching approaches that challenge traditional thinking and generate new knowledge (Blaikie, Daigle and Vasseur, 2020).

e-Learning constitutes a socio-technical system involving an intricate interplay between human and technological elements (Mlitwa, 2007). Consequently, research in the field of educational technology should adopt a socio-technical approach to explore the activities and interactions among teachers, learners, and technology (Tatnall, 2019). This study employs posthumanism as a broad philosophical perspective and uses Actor-Network Theory (ANT) as its methodological approach to educational technology.

4.2 Actor-Network Theory

ANT provides a useful framework for studying technology-mediated teaching practices because it emphasizes the role of both human and non-human actors (Rowan and Bigum, 2003; Latour, 2005; Law, 2009). For this reason, ANT can be applied as a theoretical lens to critically explore the dynamics of access to and use of ICT in an educational context.

ANT maintains that social organisations are not made up solely of people and does not favour the human over material matters or technology (Rowan and Bigum, 2003; Tatnall, 2019). ANT, therefore, allows a researcher to analyse a complex social setting in which both human and non-human are seen as a dynamically interacting network within which each part influences the other parts (Thomas and De Villiers, 2002; Matthews, 2021).

In this study, ANT was employed to explore technology-mediated teaching practices and to analyse the interactions between teachers, learners, and technology in the context of the COVID-19 pandemic. ANT was used to identify the various actors involved in the process, examine their interactions, understand technology usage, and assess its integration into teaching practices.

5. Key Findings

The qualitative research design allowed the researcher to gain a thorough and profound insight into a complex phenomenon by revealing concealed experiences within a specific social setting (Merriam, 1998; Denzin and Lincoln, 2011; Creswell and Creswell, 2018). Since qualitative findings do not lend themselves easily to generalisation owing to the absence of statistical analysis (Hammersley, 2007; Merriam, 2009), this study aimed to uncover, explore, and explain recurring patterns instead. The findings of the study highlighted the complex relationship between access to and use of ICT and the critical importance of context.

5.1 Dynamics of Access to and use of ICT

Before the pandemic, the use of ICT was optional, and teachers mainly used it to assist in or mimic conventional classroom methods. Nevertheless, the COVID-19 pandemic mandated that teachers use ICT for remote instruction, primarily driven by the need to adhere to social distancing measures. Many stakeholders in the field of education had anticipated that the technological advancements brought about by the COVID-19 pandemic would persist into the period after the pandemic. Yet, the outcomes of this investigation suggest that the connection between teachers' access to and their actual use of ICT is more complex.

The findings of this study revealed that during the pandemic, teachers experienced enhanced physical access to ICT and developed a more favourable view and deeper comprehension of the advantages of ICT in education. Consequently, some teachers began to incorporate innovative technology-driven teaching methods. Regrettably, when schools resumed their standard operations, most of the participants in this study predominantly reverted to conventional teaching approaches. The findings suggest that the boost in intrinsic motivation to use ICT was a transitory phenomenon. This suggests that motivation is not an inherent outcome of having physical access or skills but is a separate element that inspires teachers to actively explore and employ ICT. Motivational access to ICT signifies that teachers recognise its advantages and possess the necessary pedagogical knowledge and opportunities to integrate it into their teaching practices effectively (Kennedy and Cronjé, 2023).

In summary, the findings from this study propose that access does not follow a simple linear progression of consecutive stages. Physical access may serve as a fundamental requirement, but it does not inherently result in the sustained use of technology. The integration of technology into teaching and learning represents a multifaceted process that necessitates a more interconnected, relational perspective of access within educational settings, one that motivates and empowers teachers to use ICT in their teaching methods (Kennedy and Cronjé, 2023).

5.2 Critical Importance of CONTEXT

This study highlights the critical importance of CONTEXT in the dynamics of access to and use of ICT in schools. Existing studies have typically been localised case studies, primarily concentrating on technical aspects, overlooking the broader contextual factors of ICT integration. The theoretical constructs reviewed and employed all acknowledge and incorporate CONTEXT as a key variable in the relationship between access and use.

- Access to interrelated resources

This model describes what people use, need and draw on in order to acquire access to and use ICT in terms of different resources namely technology resources; resources for personal agency; *contextual* resources; and online content resources (Czerniewicz and Brown, 2005). The framework is based on the notions that (1) ICT is not used in a vacuum but is shaped by the social and cultural *context* in which it is used and (2) a binary view of ICT use for educational purposes provides an *uncontextualised* perspective.

- Digital inequality

ICT integration in SA is embedded in a systemically different *context* to that in developed countries (Sadeck, Chigona and Cronjé, 2020). In South Africa, diverse social and educational *contexts* significantly influenced access to and use of ICT during the pandemic. Jansen's dimensions of digital inequality add a South African *contextual* element to Van Dijk's cumulative model of access.

- Digital maturity

The digital maturity model recognises the need to *contextualise* both the internal and external environments in which schools operate. The majority of South African schools have not yet reached a stage where ICT is deeply ingrained in their school leadership and vision (Policy Brief, 2018; Van Greunen, Kativu and Veldsman, 2021).

- Revised TPACK model

The revised TPACK model provides for *Contextual* Knowledge (XK) to refer to a teacher's awareness of available technologies, and knowledge of the school, district, provincial, or national policies they operate within. Contextual knowledge is of critical importance, and a lack of it limits the effectiveness and success of a teacher's attempts at technology integration.

- ANT as theoretical lens

Various *contexts* and factors promoted or hindered teachers' appropriation of ICT. This study applied Actor-Network Theory (ANT) as a theoretical lens to explore the complex human and non-human actors. The analysis, interpretation, and reporting of the findings were guided by the Actor-Network Diagram as illustrated in Figure 5. The diagram was designed to identify the main *contexts* and actors in the network (Table 3), trace how each actor is linked to other actors, and illustrate the relationships and interactions between the human and non-human actors.

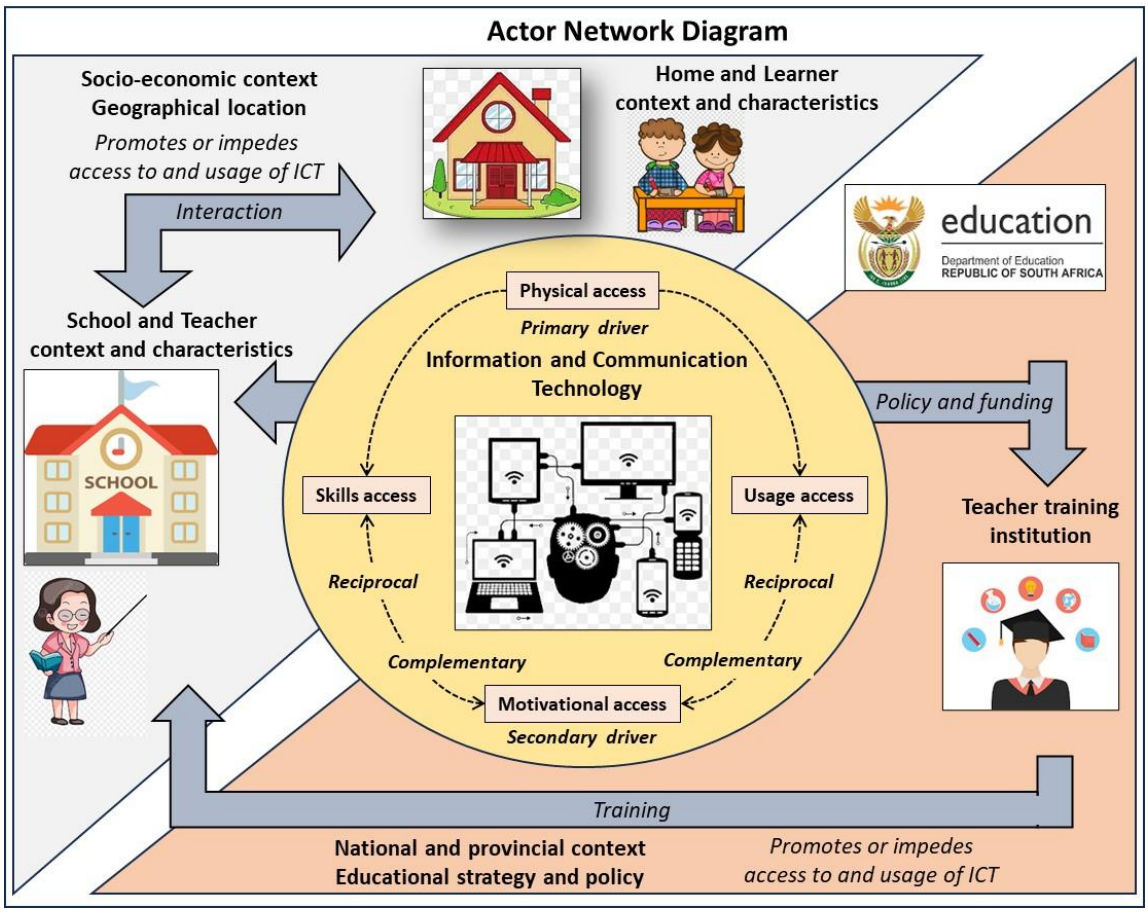

Figure 5: Actor-network diagram (author's construct)

Table 3: Actors in the network

Human actors	Non-human actors
School management Technical support staff Teachers	School environment
Parents Learners	Home environment
	Education department
	Teacher training institutions
	Information and Communication Technology Socio-economic context Geographical location

Despite the critical importance of *context*, South African education policy narrowly focuses on physical access to ICT which results in unrealistic expectations about ICT initiatives in schools. Just providing digital devices to schools, teachers, and learners is not the complete solution. Policymakers should adopt a more comprehensive and context-aware approach that considers all the factors and actors influencing ICT access and their interconnectedness. Building on Van Dijk's cumulative model of access, this study proposes an ICT appropriation model that considers and incorporates a broader contextual approach.

6. Context-Aware ICT Appropriation Model

The Context-Aware ICT Appropriation model (CAIA), illustrated in Figure 6, expands on Van Dijk's cumulative model of access by incorporating (1) the areas and associated elements of the ICT Readiness tool and (2) contexts and contextual factors identified in the ANT diagram.

The CAIA (*pronounced as KAH-ya*) model adds a unique and culturally relevant dimension to the model. The Zulu word "kaya" has significance in various African languages and cultures, often referring to a homestead or village. Depending on the specific context, it can symbolize community, belonging, and a sense of place. The term "kaya" conveys the idea of a sustainable and community-based approach to ICT implementation in schools. It implies that the CAIA model is not just a theoretical framework but also deeply rooted in the local context and culture, emphasizing the importance of community and shared knowledge in the implementation process.

The model's name thus effectively conveys its emphasis on context awareness within ICT access. It underscores the importance of adapting to various contextual factors when dealing with ICT, and its acronym, CAIA, offers a succinct reference for discussions and documentation. This suggests that the model is attuned to users' specific needs and circumstances, a valuable feature in the domain of access to and use of ICT. Overall, CAIA is a robust choice for a model emphasising context awareness in ICT access.

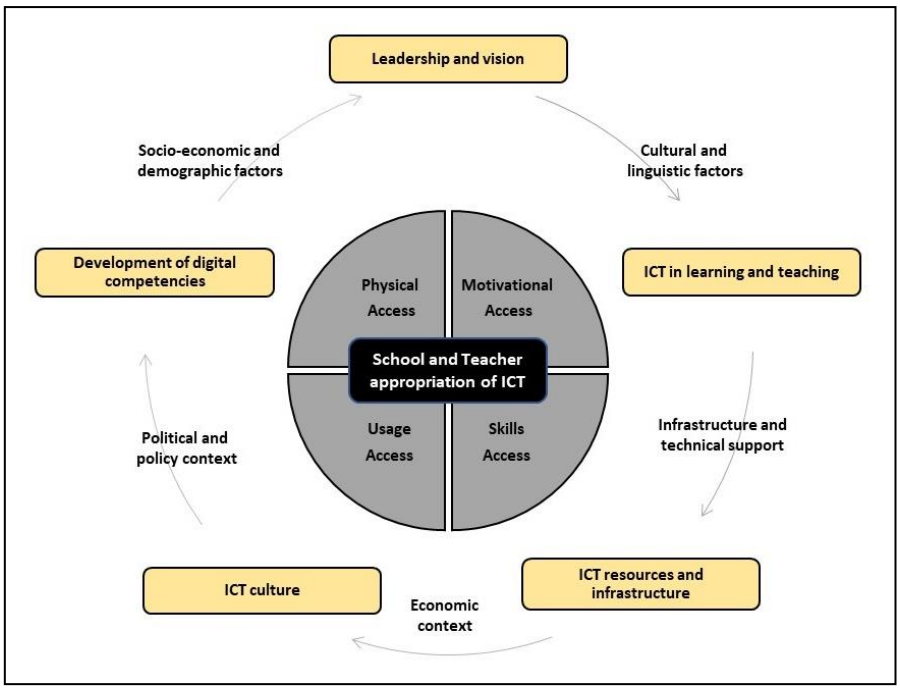

Figure 6: The Context-Aware ICT Appropriation model (CAIA) (Author's construct)

Applying this model will provide a more comprehensive understanding of a school's strengths and weaknesses in terms of technology integration. This knowledge should guide the school's ICT integration strategy and plans, ensuring the sustainability of ICT implementation projects within educational institutions. Schools must develop a comprehensive ICT strategy, setting out the aims, principles, and strategies for the adoption and use of ICT, with the input of all stakeholders. The ICT strategy must guide teachers and learners in navigating through the ICT environment and enable the integration of ICT in teaching and learning. Secondly, schools must continuously monitor and improve their e-readiness, in other words, the school's capacity and capability to provide appropriate structures to deliver effective educational experiences using ICT.

7. Conclusion

The study was motivated by the absence of a thorough understanding of teachers' access to and use of ICT in varying scenarios. The findings of this study suggest that the relationship between teachers' access to ICT and their actual use of it is not straightforward. While physical access is a fundamental requirement, it does not automatically translate into effective technology use. This research asserts the need for a more intricate and nuanced understanding of the multifaceted concept of ICT access, one that more accurately reflects how teachers actively interact with ICT in an increasingly technology-driven society.

The researcher believes that this study has enriched the theoretical and practical aspects of the field, laying a foundation for future research. Evaluating the CAIA model's practical effectiveness and its ability to overcome the limitations of isolated technology interventions is essential. The researcher advocates for future studies to assess the practicality and effectiveness of the proposed CAIA model. This encourages further examination of the model's real-world applicability and efficiency.

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