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Dear TOJDE Readers,

Welcome to Volume 26 Issue 2 of TOJDE.

There are 15 articles in the April 2025 issue of TOJDE. 48 authors from 7 different countries contributed to the issue. These countries are Indonesia, Morocco, Sri Lanka, Turkiye, United Arab Emirates, United Kingdom and USA.

AMBIVALENT LEARNER SATISFACTION IN RELATION TO TEACHING, COGNITIVE AND SOCIAL PRESENCE IN DISTANCE EDUCATION, authored by Kadir KOZAN, Sihan JIAN and Kharon GRIMMET, is the first article. The purpose of this mixed-methods study is to investigate learners' satisfaction and presence levels in five fully online graduate courses in special education that were offered in an eight-week semester, and whether there is any teaching, cognitive and social presence differences among the levels of learner satisfaction. All these findings indicate that: (a) learner satisfaction in distance education is a complex construct having multiple dimensions; and (b) achieving positive satisfaction in distance education increases teaching, cognitive and social presence levels, which can enhance learning.

The title of the 2nd article is TOWARDS AN ADAPTIVE LANGUAGE MOOC: EXAMINING DIFFERENCES OF LANGUAGE ERROR PATTERNS ACROSS CULTURAL DOMAINS. The authors are Ozlem OZAN, Yasin OZARSLAN and Sevgi CALISIR ZENCI. This study analyzes linguistic errors as part of the Differentiated Distance Education of Turkish as a Foreign Language Project, which pursues the development of an adaptive MOOC for Turkish as a second language. According to this study, there is a relationship between error frequency and the language family of the learner's mother language.

The 3rd article, IMPROVING ONLINE LEARNING USING DEEP LEARNING AND STUDENT'S INTELLIGENCES, is written by Jamal Eddine RAFIQ, Abdelali ZAKRANI, Mohammed AMRAOUY, Said NOUH and Abdellah BENNANE. This study provides a detailed overview of the APPMLT-CBT model, its data collection methodology, and discusses its potential implications for online teaching. Results suggest that the model can serve as a robust framework for improving online teaching and learning while offering a deep understanding of the underlying mechanisms of online learning.

INVESTIGATING THE FUNCTIONALITY OF FLIPPED VIRTUAL CLASSROOM MODEL SUPPORTED BY MOBILE LEARNING ENVIRONMENTS IN CLASSICAL GUITAR EDUCATION is the title of the 4th article, and the authors are A. Aylin CAN, Umit Kubilay CAN and Kutbettin KUYUMCU. This study aims to reveal how guitar teaching with the flipped virtual classroom model supported by mobile learning environments influences the students' performance skills and the achievement of the lesson outcomes. According to the results of this study, it can be concluded that the guitar education conducted with the flipped virtual classroom model supported by mobile learning environments improved the performance of the students and contributed to their achievement of the program outcomes.

Rusen MEYLANI, Gary G. BITTER and Jane M. LEGACY are the authors of the 5th article titled IMPACTS OF PROFESSIONAL DEVELOPMENT AND IMPLEMENTATION FIDELITY ON ONLINE MIDDLE SCHOOL MATHEMATICS: A QUASI-EXPERIMENTAL QUANTITATIVE STUDY. The primary goal of this study is to evaluate the efficacy of professional development and implementation fidelity on the performance of middle school students in mathematics within an online learning environment. This research enhances the understanding of strategic professional development and its significant role in improving the effectiveness of online mathematics education.

The title of the 6th article is HOW VALID ARE OPEN UNIVERSITY EXAM PASSING STANDARDS? CONSISTENCY OF CLASSIFICATION BY CUT-OFF POINTS. Hakan BARAN and Murat AKYILDIZ are the authors. The purpose of this study is to investigate whether the minimum passing scores used in Open Education examinations differ from the currently used minimum passing scores according to different standard-setting methods and the classification consistency of the cut-off scores obtained by these methods with the currently used cut-off scores and with each other. The authors highlight that the pass or fail decisions based on academic principles differed from those based on administrative decisions.

EXPLORING THE IMPACT OF ARTIFICIAL INTELLIGENCE IN ENHANCING THE EFFECTIVENESS OF DISTANCE EDUCATION: THE MODERATING ROLE OF STUDENT ENGAGEMENT is the 7th article. Blasius Erik SIBARANI is the author. This research aims to examine the impact of artificial intelligence and student engagement in enhancing the effectiveness of distance education and to test whether student engagement strengthens the impact of artificial intelligence usage in improving the effectiveness of distance education. The study shows the importance of synergy between AI technology and student engagement, thus providing insights for educators and policymakers to optimize distance education strategies to improve the effectiveness of distance education.

The authors of the 8th article are Teti SOBARI, WIKANENGSIH, R. Ika MUSTIKA and Diena San FAUZIYA. The title is EFFECTIVENESS OF FLIPPED VIDEO-BASED FEEDBACK IN ONLINE CLASSES AND TRADITIONAL TEACHING ON THE QUALITY OF WRITING COMPONENTS AND STUDENTS' WRITING SKILLS. The aim of this research is to examine the effectiveness of video feedback in improving the quality of writing components and writing skills using flipped in online class and traditional teaching. The implication of this research is that teachers can combine feedback with media to create innovative and effective learning processes in improving product quality and student abilities.

Ibrahim GOKDAS, Fulya TORUN and Serife AK are the authors of the 9th article. The title of this article is DETERMINATION OF FACTORS AFFECTING THE SATISFACTION OF INSTRUCTORS IN DISTANCE EDUCATION USING CHAID ANALYSIS. The findings of this study indicate that the general satisfaction of the instructors is at a good level. Also, it is determined that the suitability of the course for distance education, the willingness to teach online, gender, Internet Access/speed, and age played an important role in instructors' satisfaction levels.

The 10th article which is authored by Duygu GUR and Yalin Kilic TUREL is titled BEYOND PLAY: SYSTEMATIC INSIGHTS INTO GAMIFYING EDUCATION ACROSS PEDAGOGICAL, PERSONAL, AND GAMIFICATION DIMENSIONS. In this study, authors aim to reveal current research trends regarding gamification in education, identify current research needs, and make suggestions to guide future research through the systematic review. In conclusion, they provide practical suggestions for educators and instructional designers on how to apply gamified learning environments.

MULTISTAKEHOLDERS GOVERNANCE FRAMEWORK FOR ONLINE LEARNING MARKETPLACE CONSORTIUM: POWER DYNAMIC PERSPECTIVE is the 11th article authored by Ira GERALDINA, Julia SAFITRI, Paulina PANNEN and Eka JULIANTI. This research paper uses a case study approach to explore a model that is adequate and suitable to be applied in the context of the Indonesia Cyber Education Institute, which was initiated by Universitas Terbuka, Indonesia. This study contributes to distance learning education to promote governance practices and support a high-quality distance learning education for society.

The title of the 12th article is CRITICAL FACTORS INFLUENCING FACULTY'S SWIFT TRANSITION EXPERIENCES TO VIRTUAL LEARNING ENVIRONMENTS DURING EMERGENCIES: A MIXED-METHODS STUDY OF A SEMI-GOVERNMENT EMIRATI UNIVERSITY. The authors are Semiyu Adejare ADERIBIGBE, Maher OMAR, Hussein ELMEHDI, Laura COLUCCI-GRAY, Khaled HAMAD, Abdallah SHANABLEH, Hussein AL-OTHMAN, Mohamed Hassan TAHA and Wiam ELSHAMI. This study offers several recommendations, including customized training programs, policy revisions, reduced teaching loads, enhanced technological support, and the incorporation of innovative teaching methods.

Edgar OCTOYUDA, Hendra Sakti Putra SIAGIAN and Ivon ARISANTI are the authors of the 13th article titled CONFIGURING VIDEO-BASED LEARNING AND ONLINE LEARNING EXPERIENCE TO SHAPE STUDENTS' SATISFACTION. The results of the study offer both theoretical and practical insights that enable institutions to assess the degrees of satisfaction among students, distinguishing between those with high and low levels.

The 14th article titled THE MEASUREMENT OF UNIVERSITY STUDENT'S INTENTION TO USE THE REAL-TIME ONLINE LEARNING IN SRI LANKA is authored by Arthika RAJARATNAM. The findings of this study are beneficial specifically to the policy makers to formulate key strategies to incorporate the real-time online learning in the education system. Thus, the education will become more accessible and affordable.

The 15th article, E-LEARNING STYLES AS A PREDICTOR FOR ATTITUDES TOWARDS DISTANCE EDUCATION: A RELATIONAL RESEARCH WITH THE TEACHER CANDIDATES, is authored by Engin DEMIR and Huseyin CEVIK. The study aims to investigate whether various variables and e-learning styles predict student's attitudes towards distance education. Findings show that the preferred type of education, gender, visual-auditory learning style, and independent learning style predict the attitude toward distance education. In conclusion, this research sheds light on how student-centered distance education models can evolve in the process of digital transformation in education.

Hope to meet again in the next issue of TOJDE.

Cordially,

Dr. T. Volkan YUZER

Editor in Chief

AMBIVALENT LEARNER SATISFACTION IN RELATION TO TEACHING, COGNITIVE AND SOCIAL PRESENCE IN DISTANCE EDUCATION

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ABSTRACT

The purpose of this mixed-methods study was to investigate learners' satisfaction and presence levels in five fully online graduate courses in special education that were offered in an eight-week semester, and whether there are any teaching, cognitive and social presence differences among the levels of learner satisfaction. The participants were 97 graduate students enrolled in an online special education program. The qualitative results indicated a multifaceted learner satisfaction profile including mixed or ambivalent satisfaction with different levels of positive and negative aspects. The quantitative analyses, conducted in RStudio, revealed that most of the learners had ambivalent satisfaction, and that only learners with positive satisfaction reported higher teaching, cognitive, and social presence compared to those who had ambivalent and negative ambivalent satisfaction. All these findings indicate that: (a) learner satisfaction in distance education is a complex construct having multiple dimensions; and (b) achieving positive satisfaction in distance education increases teaching, cognitive and social presence levels, which can enhance learning.

Keywords: Ambivalent satisfaction; cognitive presence; online education; social presence; special education; teaching presence.

INTRODUCTION

Learner or learning satisfaction is an important factor in online education (Alman et al., 2012; Bray et al., 2008; Dziuban et al., 2015; Fang et al., 2023; Palmer & Holt, 2009) because of its potential effects on the success of online or hybrid learning (Vernadakis et al., 2012) from different perspectives including active learning and collaborative learning (Emmanouilidou et al., 2010). Similarly, learner satisfaction is also important in blended learning (e.g., Batista-Toledo & Gavilan, 2023; Lim et al., 2008), and knowing about satisfaction would also directly inform program design and relevant support systems (Bray et al., 2008). Earlier research also suggested that learner satisfaction can relate to other important factors including perceived learning (Fredericksen et al., 2000; Kozan, 2016; Richardson & Swan, 2003), learner persistence in relation to the relevance of content (Levy, 2007; Park & Choi, 2009), interaction (e.g., Dharmadjaja & Tiatri, 2021; Kuo et al., 2013; Swan, 2001), and academic performance and completion rates (e.g., Sweeney, 2016).

Previous research also highlighted that learners' satisfaction is closely linked to completion rates and the quality of instruction (e.g., Kuo & Belland, 2016) as well as retention rates (e.g., Kuo et al., 2014), and dropout rates and grade point average (e.g., Choi & Park, 2018). For instance, Choi and Park (2018) showed that satisfaction can be both directly and indirectly (through grade point average) related to dropout rate, and it can also interact with other factors such as physical constraints and interaction with course content. Likewise, earlier Community of Inquiry framework research touched on learner satisfaction (e.g., Kozan, 2016; Rubin et al., 2013; Swan, 2001). For example, Kozan (2016) found that when there are high levels of teaching, social, and cognitive presence, perceived learning, and learner satisfaction may be the same factors in online education. Interestingly, learner satisfaction may not necessarily be positive or negative, or high or low only: Ambivalence or having positive and negative emotions simultaneously (Dziuban et al., 2015) is also possible and common (Dziuban et al., 2013). Specifically, according to Dziuban et al. (2013), ambivalence is much more common than expected, and ambivalence may increase the number of factors learners use to evaluate their online courses.

Accordingly, ambivalent satisfaction can also affect learners' teaching, cognitive and social presence levels since it is reasonable to expect online learners to get involved in providing peer feedback (teaching presence), interacting with their peers (social presence), and exploring solutions to issues (cognitive presence) more as their level of satisfaction increases. However, we still need to know how teaching, cognitive, and social presence would change across satisfaction levels in fully online education including its ambivalent level, which is an underexplored research issue.

The Community of Inquiry Framework and Learner Satisfaction

The Community of Inquiry (CoI) framework (e.g., Garrison, 2013; Garrison et al., 2000, 2010; Richardson et al., 2024; Richardson & Kozan, 2017) focuses on three components: teaching, cognitive and social presence. Teaching presence refers to "the design and organization of instruction, and especially the facilitation of productive discourse among students" (Shea & Bidjerano, 2009, p. 545). It also includes designing and facilitating cognitive and social processes to promote learning outcomes (Anderson et al., 2001; Garrison et al., 2000). Cognitive presence is "the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication" (Garrison et al., 2000, p. 89). Social presence is "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352). The presences have strong interrelationships (Kozan & Richardson, 2014a) and the CoI framework assumes that meaningful learning occurs through their interaction (Garrison et al., 2000). As a result, meaningful learning occurs in a critical community of inquiry where teaching, social and cognitive presence exist at higher levels and interact with each other (Garrison et al., 2000).

Within the scope of the CoI framework, earlier research addressed the presences, perceived learning, and satisfaction (e.g., Arbaugh, 2008; Shea et al., 2005). Learner satisfaction in online education is highly related to their presence levels (e.g., Akyol & Garrison, 2008; Arbaugh, 2008; Shea et al., 2005) and their learning (Fredericksen et al., 2000; Richardson & Swan, 2003). Accordingly, previous research established strong relationships between learner satisfaction and: (a) teaching presence (e.g., Arbaugh, 2010; Caskurlu et al., 2020; Nasir & Quick, 2016; Shea et al., 2003; Wu & Hiltz, 2004); (b) social presence (e.g., Gunawardena & Zittle, 1997; Hostetter & Busch, 2006; Richardson et al., 2017; Swan & Shih, 2005); and (c) cognitive presence (e.g., Garrison & Cleveland-Innes, 2005; Meyer, 2004).

From a teaching presence perspective, Arbaugh (2001) found that instructor immediacy or instructors' verbal and non-verbal behaviors that reduces social and psychological distance could positively predict not only learner satisfaction but also learning. Likewise, Wise et al. (2004) claimed that instructors' social presence is related to learner satisfaction and motivation. To add to these correlational insights, Wise et al. (2004) purported to check social presence effects by implementing varied levels of instructor social presence on learner performance and satisfaction in a one-to-one mentoring context. The results of this study indicated no effects on learner satisfaction, engagement, perceived learning, and learning outcomes.

This finding does not align with earlier research pointing to the importance of interaction with instructors in distance education (e.g., Fredericksen et al., 2000; Johnston et al., 2005; Kuo et al., 2014; Swan, 2001; Zhang et al., 2016) especially in large online learning contexts (e.g., Grady, 2013; Russell & Curtis, 2013). For instance, Swan (2001) asserted that interactions with instructors would increase perceived learning and learner satisfaction more than interaction with other learners. Likewise, Zhang et al. (2016) found a positive relationship between teaching presence and learner behaviors and interactions, which relates to learner satisfaction as well. Hosler and Arend (2012) also reported that teaching and cognitive presence could significantly predict course satisfaction.

As for learners' social interaction, earlier studies revealed inconclusive results. For instance, there are studies suggesting that social interaction or learner interaction is not directly related to satisfaction (e.g., Bray et al., 2008; Swan, 2001). Still, some other studies indicated the opposite (e.g., Dharmadjaja & Tiatri, 2021; Hostetter & Busch, 2006; Zhang & Mei, 2013). Hostetter and Busch (2006) indicated that social presence levels would be comparable in online and face-to-face learning environments, and that social presence can predict learner satisfaction in online education. Zhang and Mei (2013) found that social presence is closely linked to learner achievement and satisfaction, which was stronger in an online learning context than a face-to-face one. Kuo et al. (2014) also found that learner to learner interaction significantly and positively relate to learner satisfaction. Likewise, Bulu (2012) found social presence to be the best predictor in a Second Life learning context. In other words, previous research indicated that social presence can strongly relate to learner satisfaction in online education (e.g., Cobb, 2009, 2011; Richardson & Swan, 2003) and virtual environments (e.g., Bulu, 2012).

Some other research also linked both teaching and social presences to learner satisfaction: Combining instructor teaching presence and social presence, Ladyshewsky (2013) claimed that instructor presence is crucial to enhance learner satisfaction in online courses. Likewise, Cobb (2011) reported that social presence and instructor performance relate to learner satisfaction and perceived learning. Accordingly, it is not surprising that learners who receive motivating emails would achieve higher final grades than those who do not (e.g., Robb & Sutton, 2014). From an interaction perspective, Dharmadjaja and Tiatri (2021) reported that all interaction types (i.e., learner-content, learner-learner, and learner-instructor) are positively related to learner satisfaction in online learning together with perceived usefulness and ease of use. The authors also highlighted that longer online learning experiences would increase learner satisfaction.

In a hybrid learning context, Giannousi and Kioumourtzoglou (2016) found that cognitive presence was the best predictor of learner satisfaction, and cognitive, social, and teaching presence predicted satisfaction as a group. Similarly, even though Hosler and Arend (2012) found teaching and cognitive presences as significant predictors of course satisfaction, cognitive presence was the leader with the highest unique contribution, and Yang et al. (2016) found that cognitive presence has the strongest relationship with learner satisfaction. According to Garrison and Cleveland-Innes (2005), teaching presence is already crucial for not only creating but also sustaining cognitive presence in online learning. In this sense, Hosler and Arend (2012) indicated that discourse facilitation dimension of teaching presence leads critical thinking and cognitive presence, which would in turn promote learner satisfaction. Since the nature of triggering questions in online discussions impacted the cognitive presence level of learners' responses (Meyer, 2004), it is reasonable to assume that triggering would contribute to learner satisfaction as well as higher level of cognitive presence (i.e., resolution). Meyer (2004) also noted that direct instruction asking learners to solve a problem would also lead to the resolution or highest level of cognitive presence.

Ambivalent Learner Satisfaction

As for ambivalence in learner satisfaction under the CoI framework, it is an underexplored issue into which this paper provides insights. This lack of research is important since ambivalence impacts how students evaluate online learning experiences in that higher levels of ambivalence means learners' using more evaluation criteria (Dziuban et al., 2013). On the part of learners, ambivalence may also lead to more skepticism about their learning, and to the idea that instructional quality is uniquely linked to instructors' teaching capability (Dziuban et al. (2007). Dziuban et al. (2013) asserted that going beyond the visible contract or course syllabus, there is a second latent contract through which learners create expectations for a course and its instructor that

impacts learners' satisfaction. The latter is crucial since it is related to learners' trust relationships in an online course, which again directly impacts their satisfaction level (Dziuban et al., 2013).

Accordingly, Dziuban et al. (2013) concluded that learner satisfaction in online education is much more multifaceted than expected, and it may be impacted by instructors partially aligning with their personal prototypes. The authors further claimed that when learners have an ambivalent level of satisfaction, they can be much more analytical thereby paying attention to details more. In other words, it may become harder to satisfy learners further when they have an ambivalent satisfaction level. Unsurprisingly, then, some researchers stated that teaching presence including timely responses to learners and initiating collaborative interactions is crucial for learner satisfaction (e.g., Mahmood et al., 2012). Kuo et al.'s (2013) claim that learner-instructor interaction is important for learners' positive sentiments supports this idea.

From social presence and cognitive presence perspectives, learner-learner and learner-content interactions can also be effective. At this point, effective teaching presence can be the main driver thus increasing the levels of learner-learner and learner-content interactions that can directly serve social presence and cognitive presence respectively. Therefore, it is not surprising that Kuo et al. (2013) adds learner-content interactions to learner-instructor interaction and technology that would positively impact learner satisfaction. According to Dziuban et al. (2007), previous research highlighted various factors related to learner satisfaction with instructors ranging from interaction to facilitation to respect for learners, and the authors claimed that instructors who achieve a high level of these factors lead to higher levels of learner satisfaction independent of the instructional delivery mode.

As a result, even though learner satisfaction can be context dependent and unstable, ambivalent learner satisfaction is important since learner satisfaction is closely related to learner success in online education (Dziuban et al., 2015), and meaningful learning is also related to teaching, cognitive and social presence (Garrison et al., 2000). Therefore, it is reasonable to claim that ambivalence in learner satisfaction can change learners' teaching, social, and cognitive presence perceptions in online education since ambivalent satisfaction can make learners pickier while evaluating their online learning experiences, which is an underexplored issue. To this end, the purpose of the current research is to address whether there are teaching, cognitive and social presence differences across learner satisfaction levels including ambivalent satisfaction, which can inform how to enhance learner success or meaningful learning in online education. Specifically, the present study addresses the following complementary main questions in relation to online learning experiences of graduate learners in five fully online special education courses taken in an eight-week semester:

- What are the satisfaction and presence profiles of learners in a fully online special education context?
- Are there teaching, cognitive, and social presence differences among the learners' satisfaction levels including ambivalent satisfaction?

METHODS

Research Design

This study had an ex post facto research design since data were collected towards the end of each fully online course. In other words, the research data were collected after the fact or towards the end of the target online learning experiences, which also makes it retrospective in that participants needed to remember what had happened before. Finally, this study also employed a mixed method approach consisting of qualitative data and quantitative data (Creswell, 2014).

Setting and Participants

We collected the research data in a fully online graduate special education teacher preparation graduate program at a large public university located in the [region and country]. The online program started in 2014 with different program tracks focusing on teaching learners with mild and intense special exceptionalities. The purpose of the program is to provide learners with the teaching skills in line with the Council for Exceptional Children's standards and legal requirements as they apply to individual education plans (IEPs) and other legal documents. The courses in which research data collected were 8-week long courses covering both theoretical/conceptual and practical components. Table 1 presents the overall course descriptions:

Table 1. Overall Course Descriptions

Course	Description
Course A	This course presents insights on the characteristics of learners with mild intervention needs.
Course B	This course provides insights into social, legal, and ethical issues as they relate to special education.
Course C	This course introduces multiple methods of assessment and data sources.
Course D	This course covers successful life transitions for students with mild and intense intervention needs.
Course E	This course focuses on the characteristics of learners with intense intervention needs.

The fully online courses above were delivered in Brightspace. Overall, the courses mainly included weekly online discussions, project-based assignments focusing on application, readings and instructor videos related to weekly topics and/or practice. There were also brief videos introducing different places on campus to familiarize students with the institution in question, and the course assignments included both group and individual work items. There was an overall synchronous online seminar for all students in which invited speakers gave presentations on topics related to special education at the beginning of a semester. Feedback was provided in various ways including videos and written form. Some courses incorporated authenthic application tasks as well. For instance, in some courses, students were asked to prepare lesson plans and implement them in their classrooms or with a learner with special needs if they were not actively teaching. Finally, each course had a weekly synchronous online office hour in which course instructors and students were supposed to come together and discuss course-related stuff.

The participants of this study were a convenience sample and came from different undergraduate background ranging from psychology to education and were trying to earn a teaching license in special education. Specifically, a group of special education graduate students, separated by time and space largely, were invited to contribute to the study and the data from those who were available and agreed to participate were used in this study. The number of learners in each course, on average, was approximately 14. Besides, the number of online courses taken by the participants before the data collection ranged from 0 to 5 or more. Table 2 provides the number of learners enrolling in each course:

Table 2. Participants in Each Course (N = 97)

Course	*N*	%
Course A	22	22.70
Course B	18	18.55
Course C	21	21.65
Course D	16	16.50
Course E	20	20.60

Measures

The Qualitative Survey

The participants also completed a qualitative survey consisting of open-ended questions to indicate: (a) anything they would like to add in relation to their perception of presence; (b) how in-course interactions affected their perception of connectedness; (c) how on-campus videos affected their perception of being a part of the institution; (d) how course content videos supported their learning; (e) how videos affected their motivation; and (f) anything that would help to enhance overall course experience.

The Community of Inquiry Survey

The 34-item CoI survey instrument measures the three presences and uses a scale of (0=Strongly Disagree) to (4=Strongly Agree). The survey includes 13 questions for teaching presence (e.g., The instructor clearly communicated important course topics), nine for social presence (e.g., Getting to know other course

participants gave me a sense of belonging in the course), and 12 questions for cognitive presence (e.g., Learning activities helped me construct explanations/solutions). Validity and reliability for the CoI survey has been previously established (e.g., Arbaugh et al., 2008; Kozan & Richardson, 2014b). In this study, Cronbach's Alpha values indicated high internal consistencies: 0.96 for Teaching Presence, 0.95 for Cognitive Presence, and 0.90 for Social Presence.

Procedures

Data Collection and Preparation

This study was conducted in Spring 2023. The overall survey including the open-ended questions or the qualitative part and the CoI component were distributed to learners via Qualtrics and the learning management system used in the last week of an eight-week online semester. Data collection stopped at the very end of the semester. The first author prepared the online survey and preprocessed the data, and the third author helped with participant recruitment and creating the open-ended questions. Originally, there were 105 participants; however, eliminating cases with no data resulted in 97 participants. The 5% trimmed mean values indicated that outliers were not influential. After all, the CoI framework suggests us achieve high levels of presences since it is important to create meaningful online learning experiences. Finally, there was one participant only with a fully negative satisfaction level. Even though this participant were kept in descriptive statistics to answer the first research question, they were eliminated from further analyses addressing the second research question.

As for qualitative data, participants' responses were checked by a native speaker for any ambiguities and misspellings. There were no significant ambiguities and misspellings that would damage the meaning of participants' answers.

Data Analysis

Both Shapiro-Wilk tests and Kolmogorov–Smirnov tests showed that the quantitative presence data violated the normality assumption. As a result, descriptive statistics, the Kruskal-Wallis test, and the Dunn's test for post-hoc pairwise comparisons were used to answer research questions. The p-values for all the post-hoc analyses were adjusted using the Bonferroni method. An alpha level of 0.05 was used for all tests of significance. All statistical analyses were performed in RStudio (Version 2023.12.1+402) and effect sizes were also calculated. The second author performed the main analyses and the first author helped with assumption check.

Content analysis of the participants' answers to qualitative survey questions were completed by two coders. The two coders first came together to discuss the coding process and create a common way of coding participants' answers into positive, negative, and ambivalent categories. Next, using a random 10% of the qualitative data, the two coders separately coded participants' answers, and came together to discuss their coding results until an agreement level of 96% was achieved. Then, the coders continued to code the rest of the qualitative data separately, and, at the end, there was 89% of agreement between them. The two coders resolved the remaining 11% of disagreement by mutually discussing the codes one by one focusing on the question of why in the presence of a third researcher, which resulted in full consensus. Specifically, in Excel, color coding was utilized to increase the efficiency of the coding process: green = positive (e.g., "I loved the way the Brain Dumps were structured"), yellow = ambivalent (e.g., "It wasn't quite like being there [Covid has really hurt that also] but it was nice to see what campus looks like") , red = negative (e.g., "It had no bearing on my sense of belonging"), black = blank or no answers, and no color = not sure or not applicable (e.g., "N/A"). In other words, answers to qualitative questions were color coded to indicate whether they were positive, ambivalent, negative, or whether there was no answer, or the coder was not sure about the category of an answer.

The next process was to categorize participants into positive, positive ambivalent, ambivalent, negative ambivalent, and negative satisfaction levels. This process was conservative in that positive satisfaction required all green coding (for all six answers), and negative satisfaction consisted of all red coding (for all six answers). Ambivalence included a combination of green (positive satisfaction) and red (negative satisfaction) and/

or yellow (ambivalent satisfaction). Dividing ambivalent satisfaction into positive ambivalent and negative ambivalent levels was based on the number of green (positive) coded answers and red (negative) coded answers out of the total of six answers. Namely, when there were more positive answers in an ambivalent case, it was coded as positive ambivalent while those with more negative answers were codes as negative ambivalent. This process was first completed by the first coder and then was double-checked by the second coder with 92% agreement. The 8% disagreement was further discussed by the two coders and full consensus was reached at the end.

FINDINGS

This section presents the current findings of the current study.

Learner Satisfaction

The first research question of the present study addressed the nature of learner satisfaction and their perception of a community of inquiry as they relate to the five fully online graduate special education courses taken in an eight-week semester. This question was answered through: (a) descriptive statistics; and (b) content analysis of participants' answers to open-ended questions in the qualitative survey. Table 3 shows the descriptive results indicating one single case of negative satisfaction or one single learner who was not satisfied at all:

Table 3. Descriptive Statistics (N = 97)

Satisfaction Levels	*N*	%
Positive	44	45.36
Positive Ambivalent	37	38.14
Ambivalent	7	7.21
Negative Ambivalent	8	8.25
Negative	1	1.04

Learners' Perception of a Community of Inquiry

On average, the participants reported high levels of teaching, cognitive and social presence since mean ratings for each presence were quite high or close to their maximum (Table 4).

Table 4. Descriptive Statistics for the Presences (N = 97)

Presence	Possible Min.	Minimum	Possible Max.	Maximum	*M*	*SD*
Teaching	0	16	52	52	46.1	8.8
Social	0	12	36	36	30.8	5.3
Cognitive	0	12	48	48	41.6	7.8

Presence Differences across the Levels of Learner Satisfaction

Before running the following analyses, one single negative case was eliminated from the data set. Therefore, in the main statistical analyses, the following groups were compared in terms of their teaching, social, and cognitive presence levels (Table 5).

Table 5. Descriptive Statistics (N = 96)

Satisfaction Levels	*N*	%
Positive	44	45.83
Positive Ambivalent	37	38.54
Ambivalent	7	7.30
Negative Ambivalent	8	8.33

Kruskal-Wallis tests and the Dunn's tests with Bonferroni adjustment were employed to test whether participants with different satisfaction levels would have different teaching, cognitive, and social presence levels (Table 6).

Table 6. Presence Differences across Satisfaction Levels

Presence	Satisfaction Level	*Minimum*	*Maximum*	*Median*	*IQR*	*H*	*p*
Teaching	Positive	39	52	52	5	12.52	.006
	Positive Ambivalent	16	52	49	8.5		
	Ambivalent	20	52	43	16.5		
	Negative Ambivalent	17	52	47	20.5		
Social	Positive	21	36	34	5.5	13.19	.004
	Positive Ambivalent	22	36	32	5.5		
	Ambivalent	12	36	28	6.5		
	Negative Ambivalent	14	33	19	13.5		
Cognitive	Positive	35	48	47	5	18.69	< .001
	Positive Ambivalent	31	48	45	11		
	Ambivalent	24	48	36	8		
	Negative Ambivalent	12	47	32	24		

Results of the Kruskal-Wallis tests indicated that there were significant differences across the four satisfaction levels in terms of teaching presence, H(3) = 12.52, p = .006, η^2= .10; social presence, H(3) = 13.19, p = .004, η^2= .11; and cognitive presence, H(3) = 18.69, p < .001, η^2= .17. Following post-hoc analyses also revealed significant results. Teaching presence was significantly lower in the ambivalence group (Md = 43.0) compared to the positive group (Md = 52.0), p = .019, r = .42. Moreover, social presence was significantly lower in the negative ambivalence group (Md = 19.0) compared to the positive group (Md = 34.0), p = .014, r = .45. As for cognitive presence, it was significantly higher in the positive group (Md = 47.0) compared to both the ambivalence (Md = 36.0, p = .007, r = .46) and negative ambivalence groups (Md = 32.0, p = .004, r = .50). Finally, the results showed that only a positive level of learner satisfaction differs from lower levels of learner satisfaction regarding all presences with a medium (positive vs. ambivalent satisfaction for teaching presence; positive vs. negative ambivalent satisfaction for social presence; positive vs. ambivalent satisfaction for cognitive presence) or large (positive vs. negative ambivalent satisfaction for cognitive presence) effect size.

DISCUSSION AND CONCLUSIONS

The results revealed that learner satisfaction in online education, taken as a form of distance education in this study, can be highly multifaceted including mixed or ambivalent levels. Namely, learner satisfaction in distance education seems to be a much more complex construct than having a dichotomous nature: positive versus negative. Specifically, descriptive results suggested that it was impossible to divide satisfaction into positive vs. negative since most learners had both positive and negative satisfaction or some sort of

ambivalent satisfaction. In other words, satisfaction was not a black or white issue but a much more complex emotional reaction. As a result, when it comes to variables such as satisfaction, ambivalence seems to be important to keep in mind since people may be more inclined to have ambivalent experiences.

Still, having more positive aspects in an ambivalent satisfaction situation may indicate a higher level of successful distance education given the role of learner satisfaction (e.g., Caskurlu et al., 2020; Richardson et al., 2017; Zhang et al., 2016). For instance, in this study, positive ambivalence outnumbered ambivalent and negative ambivalent satisfaction levels suggesting that learner satisfaction was at a certain high level. Here, it is also worth providing insights into the one single negative satisfaction case that emerged. The participant revealed that: (a) there were too many group work items: "I felt like there were too many group related activities"; (b) office hours were not effective: "No, I didn't feel like I needed to attend office hours"; (c) on-campus videos were not interesting: "I really didn't care about them"; (d) content-related videos did not support: "not really"; (e) videos did not increase their motivation: "No"; and (f) they had nothing to suggest to enhance overall course experience: "No". Given the positive and positive ambivalent satisfaction were dominant in the present study, it is reasonable to regard the one single negative case as an outlier.

Moreover, the participants' teaching, cognitive and social presence levels were quite high indicating that the fully online courses were successful at establishing a learning context encouraging meaningful learning. Further, the high levels of the presences align with the mostly positive and positive ambivalent satisfaction levels of the participants: One would expect higher learner satisfaction to associate with higher levels of teaching, social, and cognitive presence. Such a relationship is not surprising since learner satisfaction and the presences are connected to each other (e.g., Yang et al., 2016; Zhang & Mei, 2013; Zhang et al. (2016). Accordingly, it is reasonable to claim that participants of this study had a significantly positive online learning experience accompanied by higher levels of teaching, social, and cognitive presence. After all, meaningful learning occurs in the intersection of teaching, social and cognitive presence (Garrison et al., 2000).

The teaching, social and cognitive presence differences among different satisfaction levels indicate that learner satisfaction influences the presences. Specifically, the finding that positive satisfaction group reported significantly higher teaching presence than ambivalent group but not than negative ambivalent suggests that it was not increased negativity in learner satisfaction that led to lower levels of teaching presence perception, but it was equally mixed or ambivalent level of satisfaction. As a result, it is very reasonable to assume that preventing ambivalent satisfaction can increase learners' perception of teaching presence. One possible explanation is that ambivalent satisfaction would keep learners confused when it comes to instructors' efforts or teaching presence. In contrast, even negative satisfaction would not lower teaching presence perception since it makes it clear that learners are not satisfied, and this may not be directly related to teaching presence. Therefore, instructors and course designers can invest in increasing student satisfaction as much as possible by paying attention to various course features including organization, facilitation and instruction. For instance, instructors and course designers can create online courses where the structure is clear and allows the participants to understand what is expected of them easily. Similarly, they can provide clear instructions as it relates to both content and course assignments, and the assignments themselves would encourage practice or application.

However, positive satisfaction group reported higher social presence than negative ambivalence group. In other words, social presence can depend on the decreasing levels of learner satisfaction more since it seems to be much more vulnerable to lower learner satisfaction. Given that social presence is related to collaborative and constructivist nature of online learning experiences, the current findings also suggest that it is better to try to increase learner satisfaction so that learners would experience higher levels of social presence, which would lead to more successful collaborative and constructivist learning experiences. Since social presence depends more on students' interactions among themselves, instructors and course designers can try to make sure that these interactions are working and useful. For instance, they would prepare guidelines for group work that help students not only respect each other's contributions but also contribute significantly. Similar guidelines can be used by instructors and course designers to make sure students can professionally voice their opinions and agree or disagree while interacting with others.

The results pertaining to cognitive presence is much more complex since positive satisfaction group reported significantly higher cognitive presence than both ambivalent and negative ambivalence groups. This finding aligns with both teaching presence and social presence results and suggests that cognitive presence is vulnerable to the effects of both ambivalent and lower learner satisfaction. Cognitive presence is the component of the CoI framework that is closest to learning. Therefore, the current finding suggests that it is better to increase learner satisfaction as much as possible above ambivalent satisfaction to increase their cognitive presence or learning. To this end, instructors and course designers can employ problems or activities that would trigger students' interest in the course content and provide access to a wide variety of resources students can explore. Likewise, the assignments can also reflect real-life practice based on the course content thereby making it easier for students to connect the content with professional practice easily.

It is also interesting that even positive ambivalence did not differ from ambivalent and negative ambivalent satisfaction for any presence types. This finding also highlights the importance of achieving more positive levels of learner satisfaction to achieve high levels of teaching, cognitive and social presence that are assumed to encourage meaningful learning based on the CoI framework. However, positive ambivalence did not matter as much as positive satisfaction either. In other words, positive ambivalence may be a proxy for positive satisfaction, but it is not still significantly different from ambivalence and negative ambivalence in learner satisfaction.

Overall, the present results reveal that positive learner satisfaction seems to increase teaching, social and cognitive presence, which would contribute to higher levels of learning in distance education. To this end, ambivalent satisfaction can function as a key threshold to keep teaching, cognitive and social presence at a certain level. In other words, it is important to prevent even mixed or ambivalent levels of learner satisfaction, which means eliminating the possibility of negative satisfaction as well. A possible way of achieving higher student satisfaction throughout online learning experiences would be running multiple formative evaluations and employing relevant interventions when necessary.

All these results and conclusions should be approached carefully due to some limitations. First, this study included five fully online courses in a specific academic field and employed convenience sampling, which reduces generalizability and asks for further research. Such a larger future study context would increase the ecological validity with randomly selected samples. In other words, the findings may be limited to the experiences of the convenience sample or participants who were available and agreed to contribute and the field of special education. Therefore, further research would include more purposeful or random sampling and other academic fields to gauge the extent to which the current findings can generalize. Second, there was one time data collection in this study, and future research can collect data multiple times in a semester thus checking presence and satisfaction levels in a longitudinal manner. Third, the current study did not include any instructor-related data in relation to the presences and learner satisfaction. Therefore, future research would focus on instructors and their online teaching as well. Finally, similar future research can address not only online learning but also blended or hybrid learning as well, which may enhance our understanding of how to increase teaching, cognitive and social presence, and learner satisfaction in a larger educational context.

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TOWARDS AN ADAPTIVE LANGUAGE MOOC: EXAMINING DIFFERENCES OF LANGUAGE ERROR PATTERNS ACROSS CULTURAL DOMAINS

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ABSTRACT

This study analyzed linguistic errors as part of the Differentiated Distance Education of Turkish as a Foreign Language Project, which pursues the development of an adaptive MOOC for Turkish as a second language. Therefore, the Turkish CEFR (Common European Framework of Reference for Languages) A1-level writing exam papers of 177 learners were analyzed. Linguistic error analysis techniques were used. A Chi-square test of independence, a Kruskal-Wallis H test, and a Mann-Whitney U test were conducted to examine the data. The results show a relationship between error frequency and learner group (Arabic–Farsi, Turkic, Balkan, and Other). Similarly, the error density varied as a function of the learner group. There is also a relationship between error frequency and the language family of the learner's mother language. On the other hand, there is no significant difference in error density by language family. The number of languages the learner knows, has no significant effect on error frequency and density. The findings suggest that there are gender-based differences in error density among learners, but that these differences are not reflected in the frequency of errors. The topics for differentiation were identified based on the error distribution of learner groups. The topic that requires the most differentiation is noun phrases. The learner groups that need the most differentiation are the Arabic and Farsi Nations, while the Turkic Nations require the least differentiation.

Keywords: Turkish as a foreign language, error analysis, second language acquisition, adaptive language MOOC.

INTRODUCTION

In recent years, technology integration in education has sparked innovative methods in language learning, notably the development of the Massive Open Online Courses (MOOCs). MOOCs, accessible to a large global audience, offer opportunities to engage with personalized course materials, lectures, and assignments.

MOOCs typically provide standardized content for all learners, while variations include connective, extended, and adaptive MOOCs. Adaptive MOOCs employ adaptive technology to personalize the learning

experience. They use intelligent algorithms and data analytics to customize content and activities based on each learner's needs and abilities. Information regarding learners' preferences, interactions, and assignments is used to adapt course materials and learning paths and to provide personalized content recommendations, targeted feedback, and individualized pacing.

In adaptive language MOOCs, the focus is on learners' language proficiency data, which is gathered using machine learning techniques and computational linguistics, with a key component being error analysis. Error analysis helps identify sources of errors, evaluates performance, and categorizes errors. The data from error analysis provides valuable insights into learners' specific linguistic challenges and helps create robust datasets for designing and implementing adaptive language MOOCs with targeted assistance. However, the absence of tools such as error analysis and corrective feedback in language MOOC platforms is one of the main problems, as Sarre et al. (2021) mention.

This study examines linguistic error analysis in the initial phase of the Differentiated Distance Education of Turkish as a Foreign Language Project, aimed at developing an adaptive MOOC for Turkish as a second language. We investigated how error patterns in frequency and density vary according to the learners' demographics (gender, number of known languages) and the source cultural domain of Turkish language learners.

LITERATURE REVIEW

In this section, to make the study even more comprehensible, firstly, we briefly explain the structure of the Turkish language. After that, we shared the theoretical background of the source cultural domains of non-native Turkish language learners. Finally, we provide theoretical approaches for defining error patterns.

The Structure of Turkish Language

Turkish belongs to the Turkic family of Altaic languages, alongside the Mongolic, Tungusic, Korean, and Japonic families. Approximately eighty million individuals in Turkiye, the Middle East, and Western European countries speak modern Turkish.

Morphologically, Turkish exhibits an agglutinative nature. The formation of words occurs through the concatenation of root words with affixes. Word formation involves the highly productive application of multiple suffixes to root words obtained from a lexicon comprising approximately thirty thousand root words, excluding proper names (Oflazer & Saraclar, 2018). The formation of a single word might convey the meaning of a whole sentence in English since Turkish words can have many inflectional and derivational suffixes. For example:

Gel+ebil+ecek+se+n -> If you will be able to come (here)

Instances of multiple derivations within a single word are frequent in Turkish. Arisoy (2009) provides an example of the word 'ruhsatlandirilamamasindaki' which consists of nine morphemes. This word conveys the general meaning 'related to (something) not being able to acquire certification'. It is a modifier of a noun within its contextual usage. Within the word itself, there are five derivations, depicted in Figure 1, wherein the process begins with the root word 'ruhsat' (certification) and culminates through five successive derivations in the form of a modifier. On average, a word in running text contains approximately three bound and unbound morphemes.

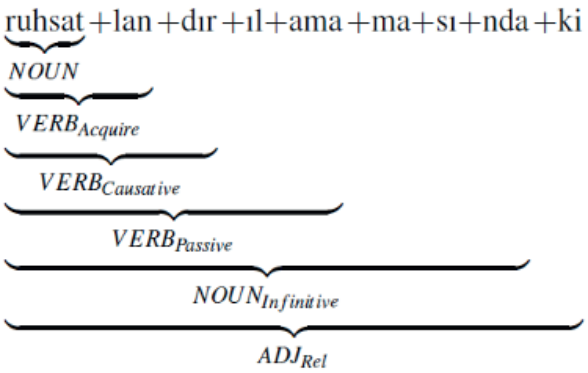

Figure 1. Derivations in a complex Turkish word (Oflazer & Saraclar, 2018)

Vowel harmony is a distinctive feature of Turkish morphology, ensuring that all the vowels within a word adhere to a consistent frontness or backness pattern, meaning that front vowels (e, i, o, u) coexist with other front vowels and back vowels (a, i, o, u) coexist with other back vowels. This system plays a crucial role in maintaining the harmonious sound structure of Turkish words. For instance:

Araba+lar; root word: car 'Araba' with back vowels (a), Suffix: -lar (plural) with the back vowel (a)

Ev+ler; root word house 'Ev' with front vowels (e), Suffix: -ler (plural) with the front vowel (e)

The default constituent order of a declarative sentence in Turkish is Subject-Object-Verb, while adjuncts can be placed relatively freely within the sentence. The example sentences below provided by Oflazer & Saraclar (2018) demonstrate variations in constituent order, each serving to encode specific discourse context and assumptions, while the main event described remains consistent: Ekin saw **Cagla**.

Ekin **Cagla'yi** *gordu. (Ekin saw* **Cagla***.)*

Cagla'yi *Ekin gordu. (It was Ekin who saw* **Cagla***.)*

Gordu Ekin **Cagla***'yi. (Ekin saw* **Cagla** *(but was not really supposed to see her.))*

Gordu **Cagla***'yi Ekin. (Ekin saw* **Cagla** *(and I was expecting that))*

Ekin gordu **Cagla***'yi. (It was Ekin who saw* **Cagla** *(but someone else could also have seen her.))*

Cagla*'yi gordu Ekin. (Ekin saw* **Cagla** *(but he could have seen someone else.)*

In conclusion, this section provides a brief overview of the key aspects of the Turkish language to facilitate a more accessible understanding of the methodological approach in error analysis. The language's complex and highly productive morphological system enables the expression of intricate concepts and nuances within a relatively concise word structure.

Cultural Domains in Turkish Language Learning

Although its agglutinative structure and relatively free constituent order make Turkish rich and effective, it also makes Turkish challenging to learn. Similarly, the Turkish lexicon might have such an effect on learning Turkish. The lexicons of root words in Turkish have been heavily influenced by Arabic, Persian, Greek, Armenian, French, Italian, German, and English because of interconnectedness and cross-cultural exchanges due to geographical proximity, cultural interactions, and temporal associations. It is not only the Turkish lexicon that exhibits this intercultural influence, but also Turkish culture itself. Turkish culture adopts, adapts, and transforms elements from other cultures while contributing its unique cultural characteristics to others. To understand the dynamics of cultural interaction, we refer to a study conducted by Ronen and Shenkar (2013).

Ronen and Shenkar (2013) consider religion, language, and geography as core variables of culture, a common lifestyle transmitted from one generation to another by acculturation and socialization. Religion could be a kind of culture because it transmits several variations of norms, values, beliefs, and behavior (Cohen, 2009)

that influence cognitions and emotions. Language commonly indicates cultural affiliation since it affects how culture members conceptualize the world. Therefore, linguistic studies highlight 'cultures of speaking' and pronunciation, vocabulary, or grammar variations. Geography also affects culture since gathering people together in a specific location depends on resource availability, climate, and population density in that particular location and represents shared values held by the groups.

In terms of these three core variables (religion, language, and geography), Turkish culture has influenced a variety of cultures and has been influenced by those cultures, especially during the Ottoman Empire period (1326-1922). At its height, the empire conquered most of southeastern Europe (including present-day Hungary, the Balkan region, Greece, and parts of Ukraine), portions of the Middle East (now occupied by Iraq, Syria, Israel, and Egypt), North Africa (as far west as Algeria), and large parts of the Arabian Peninsula (Yapp & Shaw, 2023). This wide separation of the Ottoman Empire led to a high degree of interaction between Turkish culture and the culture of occupied territories. Transcultural domains emerged among mainly Turkish, Balkan, Arabic, and Farsi nations (Yigit & Arslan, 2014) as categorized in Table 1 based on Ronen and Shenkar's (2013) study.

Table 1. Dominant Common Threads Among Cultural Domains of Turkish Learners as L2*

	SOURCE CULTURAL DOMAINS:			
	Arabic and Farsi Nations	Other Turkic Nations: Tajik Azerbaijani, Turkmen, Uzbek Kazakh, Gagauz, Oghuz, and others	Balkan Nations: Nations in the Balkan Peninsula and Southeastern Europe	Other Nations
TARGET CULTURAL DOMAIN: Turkish Culture	The dominant common thread is the *religion* between Arabic, Farsi, and Turkish cultures. The common religious belief is Islam in both cultures.	The dominant common thread is the *structure of language* between Turkic Nations. These cultures speak either Altaic languages or different dialects of the Turkish language.	The dominant common thread is *geography* between the Balkans and Turkish culture. There are still traces of the Turkish lifestyle (music, food, vocabulary, idioms) in this region since it is a former Ottoman Empire territory.	There is no common thread between source and target cultures.

**L2: Second language*

The dominant common thread is a religion among Turkish, Arabic, and Farsi cultures. All Turkic nations speak Altaic languages. Therefore, the dominant cultural common thread is the similar linguistic structure among Turkic Nations. Neither religion nor language structure is a common thread between Turkish and Balkan cultures. However, geography is. There are still traces of the Turkish lifestyle (music, food, vocabulary, idioms) in this former Ottoman Empire territory.

In addition to the commonalities above, it is crucial to consider the potential influence of source cultural domains on language errors. The dominant common thread among Turkish, Arabic, and Farsi cultures is religion. Furthermore, all Turkic nations speak Altaic languages, establishing a significant linguistic similarity. However, when examining Turkish and Balkan cultures, neither religion nor language structure emerges as a shared characteristic. Instead, geography serves as the connecting factor. Traces of the Turkish lifestyle, including music, food, vocabulary, and idioms, persist in this former Ottoman Empire territory, underscoring the enduring cultural impact across borders. Therefore, the source cultural domain may be pivotal in shaping language errors and patterns within a given linguistic context.

Theoretical Approaches to Defining Error Patterns

The errors made by second language learners, whether in speech or writing, are a subject of broad investigation and controversy among teachers, linguists, and psycholinguists (Keshavarz, 2012). According to Corder (1992), the main purpose of error analysis is to determine what a learner knows or does not know and to structure curricula and teaching activities according to the learners' needs.

Until the 1960s, it was believed that the mother tongue could influence the mistakes made by language learners, especially when these mistakes became habitual (Corder, 1992; Keshavarz, 2012). As a result, comparisons were made between the mother (source) and target languages to identify the causes of the errors. The central idea of contrastive investigation is that potential difficulties in learning a particular foreign language can be identified by systematically comparing the source and target languages and cultures.

In the ensuing decades, cognitive learning theories emerged, and error analysis techniques began to shift from the influence of the source language to the inherent difficulty of the target language, individual differences in learners, and cross-lingual influences (Doolan & Miller, 2012; Gass & Selinker, 2008; Lennon, 2008). While we cannot fully explain second language acquisition in behaviorist terms, such as native language interference, it is also incorrect to completely disregard the influence of the native language and culture (Dulay, et al, 1982; Keshavarz, 2012; Song, 2018). For instance, Jiang (2000) asserts that transfer from source language to target language is a common stage of the acquisition process. Several researchers, including Singleton (2000), Lasagabaster and Doiz (2003), Llach (2011), Naves et al. (2005), and Wang (2003), emphasize the influence of the source language on student errors.

According to Richards (1974), errors are linguistically defective or incomplete learning, such as lexical and grammatical errors, in the speaking and writing of a language. He categorizes errors into Interference, Intralingual, and Developmental Errors. Interlingual errors occur when elements from other languages are transferred into the target language. The number of languages a person knows may affect these interlingual connections (Forsyth, 2014; Neuser, 2017). Moreover, errors might arise from gender differences, with numerous studies examining gender and its implications for motivation, attitude, performance, learning strategy use, and learning style in second language learning (Almusharraf & Alotaibi, 2021).

Research on error analysis has shown that certain errors frequently recur among language learners, irrespective of their source language backgrounds, and seem more related to the intrinsic difficulty of the subsystem involved than to cross-lingual influence (Lennon, 2008). Based on this, several techniques of error analysis have been developed by scholars such as Corder (1967, 1973), Gass & Selinker (2008), and Keshavarz (2012), as shown in Table 2.

Table 2. Error Analysis Methods

Study by	Error analysis method
Corder (1967, 1973)	1. Data Collection 2. Identification of errors 3. Description of errors 4. Explanation of errors 5. Evaluation of errors
Gass & Selinker (2008)	1. Data Collection 2. Description of errors 3. Classification of errors 4. Definition of the frequencies of errors 5. Examination of error sources
Keshavarz (2012)	Data Collection a) Spontaneous (by free conversation or writing) b) Elicited (by translation, multiple-choice test) Identification Errors (Linguistic-Based Error Classification) Orthographic errors Lexico-semantic errors Morpho-syntactic errors Interpretation of Errors a) Authoritative b) Plausible

This study uses Gass & Selinker's (2008) error analysis methodology and Keshavarz's (2012) linguistic-based error classification. Keshavarz's classification is a framework for categorizing second-language writing errors based on three linguistic analysis levels; orthographic, lexico-semantic, and morpho-syntactic.

Orthographic errors (OE) involve incorrect spelling of words, possibly due to unfamiliarity with target language orthography, difficulty distinguishing between similar letters or sounds, or typing errors. Examples include:

Misspellings: e.g., 'recieve' instead of 'receive'

Omissions: e.g., 'writting' instead of 'writing'

Additions: e.g., 'accomodate' instead of 'accommodate'

Substitutions: e.g., 'teh' instead of 'the'

Lexico-semantic errors (LSE) concern the semantic properties of lexical items. These can include using an incorrect word, using a word in an inappropriate context, or misinterpreting a word's meaning. Causes could be limited vocabulary, unfamiliarity with the target language culture, or interference from the first language. Examples include the following:

Word choice errors: e.g., 'big' instead of 'huge'

Collocation errors: e.g., 'make friends' instead of 'make friends with'

Register errors: e.g., using informal language in a formal context

Idioms and expressions: e.g., 'hit the nail on the head' instead of 'hit the nail on its head.'

Morpho-syntactic errors (MSE) pertain to the grammatical structure of sentences. These can include errors in verb tenses, subject-verb agreement, word order, and punctuation. The causes could be limited knowledge of grammar rules, unfamiliarity with the target language word order, or interference from the first language. Examples include the following:

Verb tense errors: e.g., 'I go to the store yesterday' instead of 'I went to the store yesterday.'

Subject-verb agreement errors: e.g., 'The students are happy' instead of 'The students is happy.'

Word order errors: e.g., 'I love my dog' instead of 'My dog I love.'

Punctuation errors: e.g., 'I saw a cat, it was black' instead of 'I saw a cat. It was black.'

In conclusion, the study of errors in second language acquisition has evolved from focusing solely on native language interference to considering the intrinsic difficulty of the target language, individual learner differences, and cross-lingual influences. While recognizing the significant role of the native language and culture, scholars emphasize the common transfer stage from the source language to the target language in the acquisition process. Gender differences and the number of languages known also contribute to language errors. Error analysis methodologies, such as those proposed by Gass & Selinker (2008) and Keshavarz (2012), provide valuable insight into identifying and classifying errors, informing curriculum development and teaching strategies in second language instruction.

PURPOSE OF THE STUDY

Although the current literature on error analysis in English as a foreign language has laid the groundwork for further exploration, there is still a need to understand errors and error analysis in non-English foreign languages (Yigitoglu, 2015). Specifically, there is a lack of empirical research on error patterns among non-native Turkish learners. Only a few quantitative studies, such as Bayazit (2019), have begun to define these patterns with empirical evidence. However, only Kara (2010) provides detailed information about a diverse

sample. In his study of 1,324 students, Kara (2010) groups them by their native country's geographical location and spoken language. He then analyzes the error patterns of Turkish language learners using written and oral exams and surveys. Despite being a pioneering effort in understanding error patterns in Turkish as a second language, further research is needed.

This research aims to gain a comprehensive insight into how different cultural characteristics shape learners' errors at the beginner level, and investigates the following research questions:

1. What is the frequency and density of errors? (RQ1)
2. Is there a statistically significant relationship between error frequency and learner group? (RQ2)
3. Is there a statistically significant relationship between error frequency and the number of languages learners know? (RQ3)
4. Is there a statistically significant relationship between error frequency and gender? (RQ4)
5. Is there a statistically significant difference in error density by learner group? (RQ5)
6. Is there a statistically significant difference in error density by number of languages the learner knows? (RQ6)
7. Is there a statistically significant difference in error density by gender? (RQ7)

METHOD

This study uses a cross-sectional design, collecting data from a significant number of subjects at one point in time (Gass & Selinker, 2008). Our methodology, based on Gass & Selinker's (2008) error analysis approach, includes three steps: (1) Data collection; (2) Error description, classification, and coding; and (3) Analysis of error frequency and density. The following sections will discuss each step in detail, offering a thorough understanding of the research methodology used in this study.

Participants

We grouped the source cultural domains of Turkish language learners into four categories: Arabic and Farsi Nations, Turkic Nations, Balkan Nations, and Other Nations. This classification was based on three core variables; religion, language, and geography, as reported in Ronen and Shenkar's (2013) study. Our classroom observations showed that these four learner groups exhibited different tendencies and challenges when learning Turkish. Experiencing different challenges is primarily due to their unique cultural backgrounds. For instance, Arabic and Farsi students usually quickly grasp the idea behind traditions and cultural differences, especially those based on religion, and swiftly learn the related linguistic structures. Turkic students tend to understand grammar effortlessly in a short time. Balkan students, often familiar with Turkish lifestyle, music, food, vocabulary, and idioms, typically learn vocabulary faster. In contrast, learners from other nations with no common cultural thread with the target culture often find it most challenging to learn Turkish.

Despite these observations, we lacked sufficient empirical data to substantiate them. As a result, we conducted this research to investigate whether error patterns might indicate group differences in writing samples. We examined how these error patterns varied based on learner demographics, including their source cultural domain (Arabic and Farsi Nations, Turkic Nations, Balkan Nations, and other nations).

One hundred and seventy-seven non-native Turkish learners at the A1 level participated in the study. Based on their source cultural domain, the participants were assigned to one of four groups; Arabic and Farsi Nations (LG1), Turkic Nations (LG2), Balkan Nations (LG3), or other nations (LG4). The demographics of the learners appear in Table 3, in terms of gender, age, number of languages they know, and number of errors they made.

Table 3. The Demographics of the Participants

Learner Groups	# of Participants	Gender		Age			# of Languages Learner Knows			Coded Errors
		Female	*Male*	<20	20–24	24>	None	1	2>	# of Errors
LG1: Arabic & Farsi Nations	47	21	26	16	17	14	12	30	5	810
LG2: Turkic Nations	44	12	32	11	21	12	10	31	3	569
LG3: Balkan Nations	47	30	17	15	18	14	3	23	21	478
LG4: Other Nations	39	20	19	10	23	6	18	19	2	855
Total	177	83	94	52	79	46	43	103	31	2,712

The participants in LG1 were from Afghanistan (*n* = 9), Syria (n = 8), Iraq (*n* = 7), Yemen (*n* = 7), Iran (*n* = 6), Morocco (*n* = 3), Palestine (*n* = 3), Jordan (*n* = 2), Saudi Arabia (*n* = 1), and Algeria (*n* = 1). The participants in LG2 were from Kazakhstan (*n* = 14), Kyrgyzstan (*n* = 10), Mongolia (*n* = 6), Crimea (*n* = 4), Turkmenistan (*n* = 4), Uzbekistan (*n* = 2), Tajikistan (*n* = 2), Moldova (*n* = 1), and Uzbekistan (*n* = 1). The participants in LG3 were from Bosnia and Herzegovina (*n* = 18), Albania (*n* = 7), Kosovo (*n* = 5), Montenegro (*n* = 4), Serbia (*n* = 3), Ukraine (*n* = 3), Macedonia (*n* = 2), Moldova (*n* = 1), Hungary (*n* = 1), Poland (*n* = 1), Serbia (*n* = 1), and Slovenia (*n* = 1). Finally, the participants in LG4 were from the United States (*n* = 5), Somalia (*n* = 4), China (*n* = 3), Philippines (*n* = 3), Russia (*n* = 3), Benin (*n* = 2), South Korea (*n* = 2), Haiti (*n* = 2), Comoros (*n* = 2), Bangladesh (*n* = 1), Brazil (*n* = 1), Gambia (*n* = 1), India (*n* = 1), Cameroon (*n* = 1), Colombia (*n* = 1), Liberia (*n* = 1), Mozambique (*n* = 1), Niger (*n* = 1), Swaziland (*n* = 1), Uganda (*n* = 1), Venezuela (*n* = 1), and Zambia (*n* = 1).

Data Collection

To conduct this research, Turkish and Foreign Languages Research and Application Centers across Turkiye were invited to participate. Those centers that agreed to join the study were provided with detailed instructions and were required to complete a consent form to ensure ethical compliance.

Data collection involved eight different higher education centers in Turkiye, which contributed by supplying the writing exams of participants for error coding. The exams were based on the Common European Framework of Reference for Languages (CEFR), which was established by the Council of Europe in 2011. Alongside these exams, a demographic survey was also conducted, gathering information on the participants' gender, age, and multilingual capabilities; specifically the number of languages they are proficient in. This comprehensive approach aimed to analyze language acquisition errors at the foundational A1 level, thereby providing insight into early language learning challenges within the Turkish context.

Error Description, Classification, and Coding

Our coding scheme was developed based on Keshavarz's (2012) Linguistic-Based Error Classification, which includes Orthographic Errors (OE), Lexico-Semantic Errors (LSE), and Morpho-Syntactic Errors (MSE). Table 4 reports the coding sheme of OE which refers to spelling errors..

Table 4. The Coding Scheme for OE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Letter error: (A)	Zeyif	zayif
Letter error: (B)	panyo	banyo
Letter error: (C)	sicakkanli	sicakkanli
Letter error: (C)	cunku	cunku
Letter error: (E)	mesala	mesela
Letter error: (G)	Kirgizistan	Kirgizistan
Letter error: (G)	begeniyorum	begeniyorum
Letter error: (I)	yaklasik	yaklasik
Letter error: (I)	yermi	yirmi
Letter error: (O)	uynuyoruz	oynuyoruz
Letter error: (O)	doner	doner
Letter error: (P)	bara	para
Letter error: (S)	herkez	herkes
Letter error: (S)	kizi	kisi
Letter error: (U)	Biz bulustuk	Biz bulustuk
Letter error: (U)	Kutuphaneye gidiyoruz.	Kutuphaneye gidiyoruz.
Letter: (Z)	muse	muze
Letter error: Others	tar	dar
Lowercase and uppercase errors	Kardesim ile turkce konusuyoruz.	Kardesim ile Turkce konusuyoruz.
Letter misordering	biligsyara	bilgisayar
Doubling of consonants	derss	ders
Dropping one of the double consonants	dukan	dukkan
Missing or extra letters	Basket	baskent
Sound-Letter mismatch	yeyanim	yegenim
Not writing the vowels	Geleck hafta	Gelecek hafta
Writing the word the same as it is in the learner's mother language	universitet	universite
Apostrophe errors	Batuma gidecegim.	Batum'a gidecegim.
Comma errors	Kar, ve yagmur	Kar ve yagmur
Full stop errors	Onlar ogrenciler. ve Eritre'de yasiyorlar.	Onlar ogrenciler ve Eritre'de yasiyorlar.

Table 5 reports the coding sheme of the LSE, which pertains to errors tied to the semantic properties of lexical items.

Table 5. The Coding Scheme of the LSE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Co-occurrence error	kahvalti yedim	kahvalti ettim
Conjunction error	Oda ogrenci	O da ogrenci
Incorrect word order	Resmi Ataturk'un var.	Ataturk'un resmi var.
Using one word instead of another with similar pronunciation	Sinif	sinav
Adding inaccurate extra words	Dus almak yapiyorum.	Dus aliyorum.
Omitted or missing words	Onun esinin Emine	Onun esinin adi Emine
Semantic meaningfulness	Daha sey seviyorum. Butun sey en seviyorum.	

Table 6 reports the coding sheme of the MSE, which involves errors connected to grammatical structure.

Table 6. The Coding Scheme of the MSE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Error while devoicing of 't' as 'd'	Yemekden once	Yemekten once
Error while devoicing of 'c' as 'c'	Turkce	Turkce
Error while voicing of 'g, g' as 'k'	Bebeki	Bebegi
Error while voicing 't' as 'd'	Yurta	Yurda
Error while voicing 'c' as 'c'	Kirgizca	Kirgizca
Vowel harmony error	bittiktan	bittikten
Error of epenthesis: I, I, U, U	suryor	suruyor
Error of haplology: I, I, U, U	Benim sehirim	Benim sehrim
The buffer letter '-y' error	okuacagim	okuyacagim
Vowel mutation in negative and positive structures (-ma, -me, -a, -e)	yasayorum.	yasiyorum.
Derivational suffix -lik	Pilot okuyor.	Pilotluk okuyor.
Derivational suffix -li	kisa sac	kisa sacli
Derivational suffix -siz	mutlusuz	mutsuz
Accusative case suffix -i	Ayasofya muzesi'ne geziyorum.	Ayasofya Muzesi'ni geziyorum.
Dative case suffix –e	Nijer donecegim.	Nijer'e donecegim.
Ablative case suffix -den, -dan	Trabzon'da sevgilerle	Trabzon'dan sevgilerle
Locative case suffix -de	Universitesin okuyorum	Universitede okuyorum
Plural case suffix error	3 turistik yerler var.	3 turistik yer var.
Misusage of personal suffix in verb	yaptin	yaptim
Possessive suffix error	Ben pazartesi ders var.	Benim pazartesi dersim var.
The suffix –ki error	Arkadaslarim Irakta cok ozledim.	Irakta'ki arkadaslarimi cok ozledim.
Pronoun error	benim gittim	ben gittim
Pronominal -n error	masanin ustude	masanin ustunde
Noun phrase error	dunyanin en son ulke	dunyanin en son ulkesi
Negation word (degil)	cok farkli yok.	cok farkli degil.
Negation particle '-me -ma' error	Ben tren sevmeyorum.	Ben tren sevmiyorum.
Adding inaccurate extra suffixes	Yurttada kaliyorum	Yurtta kaliyorum
Copula error	ogretnenim	ogretmenim
Present continuous tense error	O, cay seviyorun.	O, cay seviyor.
Future tense error	okuyacam	okuyacagim
Past tense error	Dort yil once ben ve Mustafa sik sik beraber ders calisiyoruz, geziyoruz, sohbet ediyoruz.	Dort yil once ben ve Mustafa sik sik beraber ders calistik, gezdik, sohbet ettik.

Under this schemes, we analyzed one hundred and seventy-seven writing exam papers and coded 2,712 errors using NVivo, a qualitative data analysis software. After coding the papers for various error types, the data was exported to a Microsoft Excel spreadsheet. After this, we created two rectangular matrices for statistical tests. The rows represent the participants, and the columns represent each participant's attributes (demographics) and errors. The first matrix was for counting error frequency, which was binary coded: a '1' was entered in a cell if the participant made an error, and a '0' was entered if no error was made. This matrix, whose structure is shown in Figure 2, indicates how many participants made a specific error.

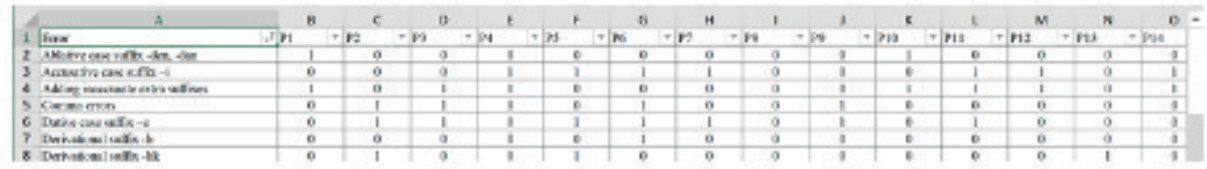

Figure 2. The structure of the error frequency matrix

The second matrix is used for error density calculation and is coded in decimal. Each cell contains the error count per participant. This matrix, whose structure is shown in Figure 3, indicates the frequency of each error made by the participant. In other words, it represents the total occurrence of a specific error.

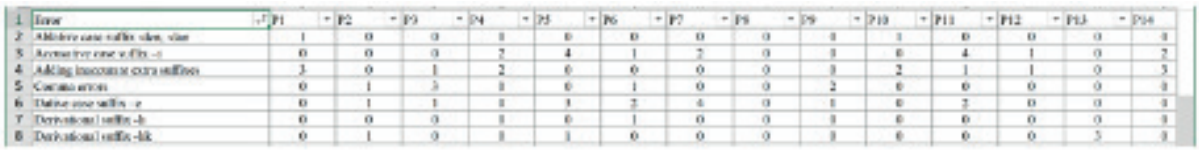

Figure 3. The structure of the error density matrix

To ensure precise and consistent categorization, we started by jointly coding 20% of the exam papers. In cases of disagreement, we engaged in discussion until we reached a consensus. We then individually coded an added 15% of the sample to assess inter-rater reliability. The coding scheme was finalized once the overall agreement rate hit 89.4%. Following Saldana's (2015) and Oswald and Plonsky's (2010) advice, each researcher coded half the remaining exam papers. Every coded error was cross-verified by another subject matter expert to ensure reliability. All coders were Ph.D students in the Teaching Turkish as a Foreign Language program and had at least four years of experience.

Analysis of Error Frequency and Density

After establishing the frequency and density matrices, we conducted inferential statistical tests. A chi-square test of independence examined the relationship between the variables in RQ2, RQ3, and RQ4. We applied a Kruskal-Wallis H test to analyze the difference between the variables in RQ5 and RQ6. Cramer's V measured the effect size for the chi-square test of independence, while epsilon square gauged the effect size for the Kruskal-Wallis H test. We also used the Bonferroni approach to evaluate pairwise differences among the learner groups. Lastly, we performed a Mann-Whitney U test to examine the difference between the variables in RQ7.

FINDINGS

This section presents the major findings of the study.

Frequency and Density of Errors

Our initial research question inquired into the frequency and density of errors. Table 7 provides a comprehensive overview of the frequency and density of the most common errors participants made.

Table 7. The Frequency and Density of Errors

		Density*		Frequency**	
Category	Error	n	%	n	%
OE	Letter error: (I)	367	9,1	109	6,5
OE	Uppercase errors	373	9,2	91	5,4
OE	Letter error: (U)	202	5,0	88	5,2
OE	Letter error: (I)	247	6,1	84	5,0
OE	Apostrophe errors	153	3,8	75	4,4
OE	Missing or extra letters	147	3,6	74	4,4
OE	Writing words the same as in the learner's mother language	170	4,2	74	4,4
OE	Lowercase errors	211	5,2	62	3,7
OE	Letter error: (E)	165	4,1	53	3,1
OE	Letter error: (U)	62	1,5	47	2,8
OE	Full stop errors	190	4,7	46	2,7
OE	Letter misordering	51	1,3	37	2,2
MSE	Noun phrase	291	7,2	111	6,6
MSE	Adding inaccurate extra suffixes	167	4,1	86	5,1
MSE	Accusative case suffix –i	171	4,2	85	5,0
MSE	Possessive Suffix	187	4,6	84	5,0
MSE	Locative case suffix -de	139	3,4	77	4,6
MSE	Sound-Letter mismatch	183	4,5	77	4,6
MSE	Vowel harmony	118	2,9	63	3,7
MSE	Dative case suffix –e	99	2,5	60	3,6
MSE	Pronominal -n	82	2,0	55	3,3
LSE	Incorrect word order	138	3,4	81	4,8
LSE	Using one word instead of another with a similar pronunciation	127	3,1	68	4,0
	TOTAL	4040	100	1687	100

* Refers to the total number of times the particular error was made.

** Refers to the total number of participants who made a particular error.

Orthographic errors related to letter errors, such as errors with the letter '**I**' and uppercase errors as well as morphosyntactic error noun phrase errors stand out as the most frequent and dense categories. These errors highlight challenges participants faced in correctly using Turkish characters and adhering to orthographic rules, and participants struggled notably with constructing and using noun phrases correctly in Turkish. Morphosyntactic errors like adding inaccurate extra suffixes, inaccurately using accusative case suffixes, and issues with possessive suffixes also appear frequently among the errors. These errors indicate difficulties participants encountered in mastering the morphological and syntactic aspects of the Turkish language. On the other hand, lexical-semantic errors, such as incorrect word order and using one word instead of another with similar pronunciation, although less frequent, still contributed significantly to the overall error distribution.

Relationship between Error Frequency and Learner Group

Our second research question asked whether there would be a statistically significant relationship between error frequency and learner group. A chi-square test of independence was performed to examine the relationship between error frequencies and learner groups. The relationship between these variables was significant, albeit with a small effect size, $x^2(66, N = 1687) = 137.964$, $p < .01$, $V = .165$. This suggests that while there is a relationship between error frequencies and learner groups, the strength of this relationship

is not particularly strong. In other words, the learner group a participant belongs to may influence error frequencies, but other factors likely also play a role. Error frequencies of learner groups are provided in Table 8 in terms of count and percentile.

Table 8. The Error Frequency* Distribution of the Learner Groups

Errors	LG1: Arabic and Farsi Nations	LG2: Turkic Nations	LG3: Balkan Nations	LG4: Other Nations	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Noun phrase	35 (32%)	23 (21%)	23 (21%)	30 (27%)	111 (100%)
Letter error: (I)	31 (28%)	24 (22%)	24 (22%)	30 (28%)	109 (100%)
Letter error: (U)	17 (19%)	23 (26%)	20 (23%)	28 (32%)	88 (100%)
Adding inaccurate extra suffixes	21 (24%)	12 (14%)	27 (31%)	26 (30%)	86 (100%)
Accusative case suffix –i	23 (27%)	12 (14%)	28 (33%)	22 (26%)	85 (100%)
Possessive Suffix	21 (25%)	13 (15%)	25 (30%)	25 (30%)	84 (100%)
Letter error: (I)	19 (23%)	24 (29%)	21 (25%)	20 (24%)	84 (100%)
Incorrect word order	22 (27%)	14 (17%)	22 (27%)	23 (28%)	81 (100%)
Sound-Letter mismatch	20 (26%)	24 (31%)	14 (18%)	19 (25%)	77 (100%)
Locative case suffix -de	23 (30%)	11 (14%)	18 (23%)	25 (32%)	77 (100%)
Writing words the same as it is in the learner's mother language	19 (26%)	19 (26%)	17 (23%)	19 (26%)	74 (100%)
Missing or extra letters	22 (30%)	15 (20%)	16 (22%)	21 (28%)	74 (100%)
Using one word instead of another with a similar pronunciation	9 (13%)	17 (25%)	17 (25%)	25 (37%)	68 (100%)
Vowel harmony	23 (37%)	10 (16%)	11 (17%)	19 (30%)	63 (100%)
Dative case suffix –e	16 (27%)	10 (17%)	16 (27%)	18 (30%)	60 (100%)
Letter error: (E)	30 (57%)	11 (21%)	2 (4%)	10 (19%)	53 (100%)
Letter error: (U)	16 (34%)	11 (23%)	7 (15%)	13 (28%)	47 (100%)
Letter misordering	13 (35%)	8 (22%)	4 (11%)	12 (32%)	37 (100%)

* Refers to the total number of participants making the particular error.

The relationship between error frequency and learner group is also provided in Figure 4 in a visual form for the sake of readability, considering the available large data set.

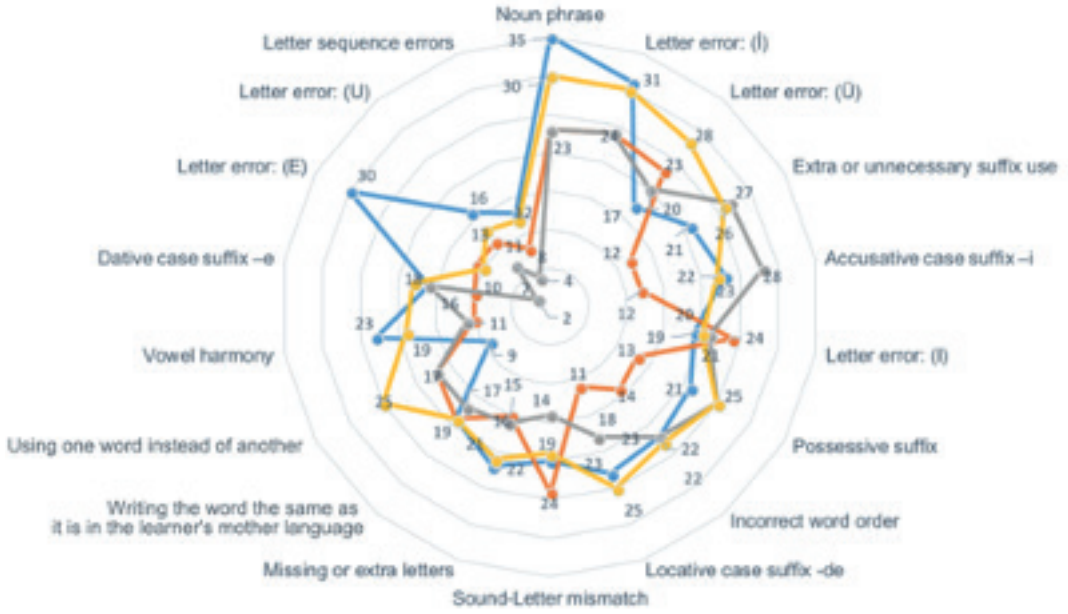

Figure 4. The Relationship between Error Frequency and Learner Group

The most common error across all groups is the 'Noun phrase', with 111 participants (32%) making this mistake. The next frequently occurring errors include letter errors like '**İ**', '**U**', and 'I'. These errors seem to be fairly evenly distributed across the learner groups, although certain slight variations can be observed. On the other hand, the letter error E is most common in Arabic and Farsi Nations while least common in Balkan nations. The Turkic Nations make accusative case suffix -i error less frequently than the other groups. In summary, while there are common errors observed across all learner groups, there are also distinct patterns and variations that can be attributed to the learners' native languages and linguistic backgrounds.

The Relationship between Error Frequency and the Number of Languages the Learner Knows

Our third research question asked whether there would be a significant relationship between error frequency and the number of languages a learner knows. A chi-square test was performed, and no relationship was found between error frequency and the number of languages the learner knows, x^2 (44, N = 1687) = 35.338, p = .82. This indicates that, knowing more languages does not appear to influence the frequency of errors made by learners. These results challenge the common assumption that multilingualism might lead to a better or worse performance in language learning.

The Relationship between Error Frequency and Gender

Our fourth research question asked whether there would be a statistically significant relationship between error frequency and gender. A chi-square test was performed, and no relationship was found between error frequency and gender; x^2 (22, N = 1687) = 24.744, p = .31. This indicates that while there might be variations in the types of errors made by male and female learners, these differences do not reach statistical significance when considering error frequency alone.

The Difference in Error Density by Learner Group

Our fifth research question asked whether there would be a statistically significant difference in error density by learner group. A Kruskal-Wallis H test showed that there was a statistically significant difference in error density by learner group; $x^2(3)$ = 39.626, $p < .01$, x^2 = 0.024. Specifically, the mean rank error

scores were 927.48 for LG1 (Arabic and Farsi Nations), 867.04 for LG4 (Other Nations), 780.70 for LG2 (Turkic Nations), and 751.17 for LG3 (Balkan Nations). Although the statistically significant difference was observed, the effect size was small, which suggests that the practical significance of the results might be modest.

Table 9. Results of Kruskal-Wallis H Test; Error Density* by Learner Group

Learner Groups	n	Mean	sd	x^2	p	
LG1: Arabic and Farsi Nations	517	2.92	3	39.626	0.001	LG1–LG4, LG2–LG3
LG2: Turkic Nations	337	2.13				
LG3: Balkan Nations	354	1.84				
LG4: Other Nations	479	2.42				

* Refers to the total number of times the particular error was made.

Follow-up tests were conducted to evaluate pairwise differences among the four groups, controlling for Type 1 error across tests using the Bonferroni approach. The results of these tests indicate a significant difference between:

- LG3 and LG4 U(N_{LG3} = 354, N_{LG4} = 479) = 72916.00, z = -3.71, p <.001,
- LG3 and LG1 U(N_{LG1}) = 517, N_{LG3} = 354) = 72331.00, z = -5.59, p <.001,
- LG2 and LG4 U(N_{LG4} = 479, N_{LG2} = 337) = 72430.50, z = -2.68, p = .007,
- LG2 and LG1 U(N_{LG1} = 517, N_{LG2} = 337) = 72248.00, z = -4.74, p < .001.

None of the other comparisons were significant after the Bonferroni adjustment. The density of errors was greater for LG1 than for LG3 and LG2. It was also greater for LG4 than for LG3 and LG2. These findings suggest that there are notable variations in error density across different learner groups, with learners from Arabic and Farsi nations exhibiting the highest error density compared to other groups. This underscores the importance of considering learner backgrounds when designing language learning interventions to address specific learning challenges effectively.

The Difference in Error Density by the Number of Languages the Learner Knows

Our sixth research question asked whether there would be a statistically significant difference in error density by the number of languages the learner knows. A Kruskal-Wallis H test was performed, and there is no statistically significant difference in error density by the number of languages the learner knows; $\mathbf{x}^2(sd$ = 2, n = 1687) = 4.870, p = 0.088. This suggests that the number of languages known by a learner may not significantly influence the density of errors made during the learning process.

The Difference in Error Density by Gender

Our seventh research question asked whether there would be a statistically significant difference in error density by gender. The results of the Mann-Whitney U test indicate a statistically significant difference in error density between male and female learners U(N_{Female} = 768, N_{Male} = 919) = 326325.50, z = -2.85, p < 0.01. The negative z-value (-2.85) suggests that female learners had a lower error density compared to male learners.

DISCUSSIONS AND CONCLUSION

Although various recent studies have practiced an error analysis approach, few studies have adopted this approach to less commonly taught languages (Kang & Chang, 2014). The error analysis approach could be highly relevant in exploring the acquisition of agglutinating languages, such as the Turkish language, in which the morphology and syntax are perceived as a source of great difficulty (Bayazit, 2019). This approach

would advance our understanding (Polio, 2013), and as Yigitoglu and Reichelt (2012) state, we may have a clear sense of Turkish learners' needs.

While there are countless studies on learning and teaching a language as a foreign language worldwide, it is noteworthy that the studies on learning and teaching Turkish as a foreign language within the scope of applied linguistics are limited. Existing studies on errors made by learners of Turkish as a foreign language exhibit limitations in terms of scope and sample size. Typically, these studies focus on specific linguistic areas and specific native language backgrounds of learners, or involve a small number of participants. Therefore, a comprehensive understanding of the errors made by Turkish language learners based on different variables is still lacking. Unlike other studies, this study tries to emphasize the comparison of four groups determined within the framework of the cultural domain as well as the effect of gender and the number of languages they know on the errors made by learners. The error typology developed within the scope of this study will be able to successfully evaluate the extent to which learners have a good knowledge of Turkish, especially spelling and grammar.

According to our results, the relationship between error frequencies and the learner group is significant. Most errors made by LG1 were noun phrase errors, vowel harmony errors, missing or extra letters, letter misordering, and letters I, U, and E errors. Other research in the field has similar results. For example, it is reported that students whose native language is Arabic and who use the Arabic alphabet make noun phrase errors (Adalar Subasi, 2010; **Cicek** & Kaplan, 2016; Kara, 2010; Polat, 1998) in addition to vowel harmony errors (Adalar Subasi, 2010; **Cicek** & Kaplan, 2016; Kara, 2010; Polat, 1998). Those students also have difficulty writing vowels in Turkish (Adalar Subasi, 2010; Bolukbas, 2011; Okatan, 2012; Kara, 2010; **Sengul**, 2014). It is reported that students are frequently confused in regard to writing the vowel sounds and use /a/-/e/, /i/-/i/ (**Cicek** & Kaplan, 2016; Kara, 2010; Okatan, 2012), /u/-/u/ (Okatan, 2012; Polat, 1998), and /e/-/i/ (**Cicek** & Kaplan, 2016; **Sengul**, 2014) interchangeably. **Sengul** (2014) states that students cannot distinguish these letters while writing because vowel sounds are not represented with a letter in the Arabic alphabet; instead, these sounds are represented with accents using above or below consonants. Kara (2010) stated that foreign students who use the Arabic alphabet, especially from the Middle East, do not write one of the double consonants in words. He claimed this error stems from making double consonants with shadda while writing in their language. It was found that the students, whose native language was Persian, and who used the Persian alphabet while learning Turkish as a foreign language, made errors in noun phrases, vowel harmony, and the mixing of similar sounds such as i-i, o-o, and u-u (Boylu, 2014; **Inan**, 2014). **Inan** (2014) states that the reasons for the errors in vowel harmony and the mixing of similar sounds, such as i-i, o-o, u-u was the fact that the phonological structure of Turkish is different from Persian, being six vowels in the Persian alphabet (/a/, / a /, / e /, / i /, / o /, / u /) in comparison to eight vowels in the Turkish alphabet, and confusion of the vowels /i/, /u/, /o/, which were especially not found in Persian, with the vowels /i/, /u/, /o/.

We found that most errors made by LG2 were letter 'I' error and sound-letter mismatch errors. Similarly, Albayrak (2010) states that Mongol students were confused about the i-i sounds. Yilmaz (2015) and **Ozdemir** and Arslan (2017) states that Kazakhs made errors with dotted vowels, and the inability to distinguish dotless vowels (3.0%) was among the important problems encountered while writing. **Ozdemir** and Arslan (2017) states that v, g, i, u, h, c, s, e, c, i, t were the vowels and consonants that Kazakh students frequently made errors with in reading and writing. Kumsar and Kaplankiran (2016) states that Kazakh students often made errors by writing the letter /i/ instead of the /i/ sound. Aydogmus (2018), Barin (1998), Erdogan (2005) and Kumsar and Kaplankiran (2016) states that students wrote /v/ instead of /b/, /s/ instead of /c/, /n/ instead of /h/, /r/ instead of /p/, /u-u/ instead of /y/, and /g/ instead of /d/. They explain that the reason for these mismatch errors is that there are many similar letters between the Turkish and Kazakh alphabets. They also state that letters are in the same form but are pronounced differently. They also explain that letters such as /c/ and /g/, are unique to the Turkish alphabet but not to the Kazakh alphabet.

According to our results, most errors in LG3 were using extra or unnecessary suffix and accusative case suffix –i errors. Similarly, Ak Basogul and Can (2014) states that students from the Balkan Nations made errors, particularly in using the accusative case suffix –i.

Most errors made in LG4 were letter U error, dative case suffix –e, using the wrong word instead of another, and locative case suffix -de errors. Our results show similarities with other studies. For example, Demir and

Gulec (2015) and **Sengul** (2014) state that their students had difficulty with the /u/ sound and used the /u/ sound instead of the /u/ sound. They claim that the main reason for these errors is the absence of the /u/ sound in the learner's mother language. Polat (2014) found no /u/ sound in Russian and; as a result, Russian learners frequently make letter U errors. In addition, he claims that Russian learners often made the dative case suffix –e and locative case suffix –de errors since the dative case suffix –e and locative case suffix –de in Russian are sometimes used with prepositions and sometimes without prepositions.

The error percentage for the letter 'i' was the same for LG1 and LG4. Using incorrect word order was an error commonly made by LG1, LG3, and LG4. Writing Turkish vocabulary with the same word as the one in the mother language was a common error for all the learner groups.

In addition, there was a statistically significant difference in error density by learner group. The results indicate a significant difference between LG1 and LG3, LG1 and LG2, LG2 and LG4, and LG3 and LG4. There was no significant difference between LG2 and LG3 in terms of error density, and there was no significant difference between LG1 and LG4. LG2 and LG3 were similar in most cases and, similarly, LG1 and LG4 were similar.

On the other hand, no relationship was found between the error frequency and the number of languages the learner knows. Similarly, there was no difference among the groups in error density by the number of languages the learner knows. These outcomes align with the findings of Neuser's (2017) investigation on lexical transfer, where a significant L1 status effect was found rather than an L2 status effect. In contrast, our research results diverge from Torusdag's (2020) findings, which indicate that students acquiring Turkish as their initial foreign language exhibit a higher frequency of written expression errors than those learning it as their second or third language. Furthermore, Forsyth's (2014) research highlights the presence of negative syntactic L2 transfer from German and Italian in English L3. The primary distinction between transfer in second language acquisition and transfer in third or fourth language acquisition lies in the learner's capacity to leverage multiple background languages when confronted with gaps in the target language (Neuser, 2017). This delineation holds significant implications for developing future language teaching strategies and systems, particularly in light of the increasing prevalence of multilingual acquisition in contemporary society.

No relationship was found between error frequency and gender. Our findings, in terms of the total number of errors by gender, are in line with the earlier research of Almusharraf and Alotaibi (2021), Lahuerta (2020), and Nair and Hui (2018). On the other hand, there is evidence to suggest that gender may influence error density in the learning process, with the female learners showing better performance in terms of error density compared to the male learners in this study.

As a result, the analysis of language errors among four distinct learner groups, LG 1 (Arabic and Farsi Nations), LG 2 (Turkic Nations), LG 3 (Balkans Nations), and LG 4 (Other Nations), revealed specific error patterns. These patterns guided the development of adaptive instructional content. For example, OEs varied across the groups; LG 1 struggled with '**I**', while LG 2 had issues with 'I.' LG 4 had problems with '**I**' and '**U**'. Both LG 1 and LG 4 showed specific letter errors with 'E' and 'U,' as well as misordering letters. Interestingly, LG 3 did not display specific OEs.

The most common MSE was the noun phrase error common among LG 1 and LG 4, which led to targeted instruction in this area for both groups. Both LG 3 and LG 4 often added inaccurate extra suffixes, necessitating tailored content addressing suffix usage accuracy for these groups. Specific suffix errors, such as the accusative case suffix '-i' and possessive suffix, were identified in LG 3 and LG 3/LG 4, respectively. LG 2 did not display specific MSEs.

Incorrect word order was a shared challenge among LG 1, LG 3, and LG 4, requiring focused instruction on this aspect. In addition G 4 struggled with writing words similar to their mother language. Interestingly, LG 2 did not display specific LSEs.

By tailoring content to address these distinct error patterns, the language acquisition process was optimized for each learner group. This facilitated more effective and targeted learning experiences. By identifying the distinct weaknesses caused by source culture, we could tailor our instructional approach, offering targeted assistance and practice opportunities to different learner groups according to their error distribution, as outlined in Table 10.

Table 10. The adaptation strategy according to the learner groups' error distribution

Error Type	Error	Learner Groups			
		LG 1: Arabic and Farsi Nations	LG 2: Turkic Nations	LG 3: Balkans Nations	LG 4: Other Nations
OE	Letter error: (I)	X			X
OE	Letter error: (I)		X		
OE	Letter error: (U)				X
OE	Letter error: (U)	X			
OE	Letter error: (E)	X			
OE	Letter misordering	X			X
OE	Sound-Letter mismatch		X		
OE	Missing or extra letters	X			X
MSE	Noun phrase	X			X
MSE	Accusative case suffix –i			X	
MSE	Locative case suffix -de	X			X
MSE	Dative case suffix –e				X
MSE	Possessive Suffix			X	X
MSE	Adding inaccurate extra suffixes			X	X
MSE	Vowel harmony	X			
LSE	Incorrect word order	X		X	X
LSE	Writing words the same as it is in the learner's mother language				X

In this study, we examined the writing error patterns of non-native Turkish learners for offering targeted assistance. The outcomes of our study have been instrumental in pinpointing specific areas where students encounter difficulties in the language. The results were used in the preparation and adaptation of teaching materials for the Learn Turkish Adaptive Massive Open Online Course (https://xxx.xxx.xxx.xx).

Overall, error analysis is a powerful tool for designing adaptive MOOCs that are more effective and efficient at helping students learn and improving their foreign language skills. It is a relatively new approach to educational design. Adaptive MOOCs are still in the early stages of development, and there is ample room for innovation. Using error analysis to design adaptive MOOCs is a novel approach to improve the effectiveness and efficiency of these courses. Moreover, this is an interdisciplinary approach; Combining error analysis with educational technology can create new and innovative ways to help students learn. There may be certain limitations to this study. The first is gathering demographic data from students through self-reporting. Formal records and in-depth interviews are ideal for obtaining background data regarding participants. However, accumulating large amounts of data from numerous learners renders self-reporting an indisputable limitation of the study. The second limitation is the language proficiency of learners. It is limited to the CEFR A1 level, where learners can understand and use basic expressions to satisfy concrete needs, such as introducing themselves and asking others questions concerning personal details. Future research is suggested to replicate this study for other CEFR levels (A2, B1, B2, C1, and C2) of language proficiency. In doing so, future researchers could gain and share important insights into students' error patterns.

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IMPROVING ONLINE LEARNING USING DEEP LEARNING AND STUDENT'S INTELLIGENCES

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ABSTRACT

The emergence of online learning has sparked increased interest in predicting learners' academic performance to enhance teaching effectiveness and personalized learning. In this context, we propose a complex model APPMLT-CBT which aimes to predict learners' performance in online learning settings. This systemic model integrates cognitive, social, emotional, contextual, and normative aspects to predict the learners' performance in online learning environment. This model, based on Competency-Based Learning Traces, takes a holistic approach by integrating various data reflecting knowledge acquisition and skills development. By Taking into account the exchanges among the learners, as well as the interactions with their teachers and the complexity of their online learning environment, the model aims to provide accurate and informed predictions of academic performance. This study provides a detailed overview of the APPMLT-CBT model, its data collection methodology, and discusses its potential implications for online teaching. Results suggest that the model can serve as a robust framework for improving online teaching and learning while offering a deep understanding of the underlying mechanisms of online learning.

Keywords: Learner's intelligences, predicting academic performance, competency-based learning, deep learning, online learning.

INTRODUCTION

Digital learning has revolutionized education, introducing new learning modalities such as online teaching. This evolution has sparked growing interest in utilizing data generated by online learning platforms, aiming to enhance teaching effectiveness and personalization (Larabi-Marie-Sainte et al., 2021). At the heart of this transformation lies the need to predict learners' academic performances, a crucial task to anticipate their individual educational needs and guide the development of tailored pedagogical strategies (Fahd et al., 2021). In this work that we propose the APPMLT-CBT model: Academic Performance Prediction Model based on Competency-Based Learning Traces. In contrast to traditional approaches such as (Haseena & Peter, 2017), (Xu et al., 2019), and (Tormon et al., 2023), often focused on quantitative measures like test scores, our model adopts a comprehensive approach. Indeed, APPMLT-CBT mobilizes multi-modal data reflecting both knowledge acquisition and skills development, aiming to provide a more accurate and informed prediction of online learners' academic performances.

Our model incorporates an analysis of digital traces across four dimensions: cognitive, social, emotional, contextual, and normative intelligence, resulting from complex interactions among learners, as well as between learners and the online learning environment. Our objective is to establish an integrated framework to predict and enhance learners' academic performance while gaining a deeper understanding of online learning mechanisms.

In this contribution, we will introduce the Academic Performance Prediction Model based on Competency-Based Learning Traces (APPMLT-CBT), emphasizing its key components and data collection methodology. This article will also report the effectiveness of the model in predicting learners' academic performance, as well as its potential implications for enhancing online teaching and personalized learning.

LITERATURE REVIEW

In the emerging field of digital education, the understanding and application of predictive models of academic performance benefit from the integration of the multiple facets of human intelligence. The evolution of the conceptualization of intelligence, as explored in studies such as (Quilez-Robres et al., 2022), highlights the importance of different forms of intelligence - emotional, social, cognitive, contextual, and normative -in predicting academic outcomes. In particular, the studies (Sanchez-Alvarez et al., 2020) and (Antonio-Agirre et al., 2019) shed light on the pivotal role of emotional intelligence and social support in the academic success of secondary education students, indicating a positive correlation with performance.

The analysis of online learning traces, enriched by indirect measures of cognitive intelligence, offers considerable potential for predicting academic performance, as demonstrated in (Otero et al., 2022). This perspective is complemented by the works of (Li et al., 2022) and (Hongsuchon et al., 2022), which reveal the significant impact of instructional interactions and normative intelligence on academic success in online learning environments. The studies by Xing Li et al., as well as Tanaporn Hongsuchon et al., underline the crucial importance of navigating and optimizing technical, communication, and academic interactions to achieve academic success.

Furthermore, research (Arnaiz-Sanchez et al., 2020) suggests that innovative learning strategies, such as collaborative and cooperative learning, can significantly improve language and mathematics skills, thereby offering paths to enhancing academic performance. These studies collectively illustrate the importance of a multidimensional approach to intelligence in designing predictive models of academic performance, suggesting that integrating these various dimensions could provide more nuanced and precise insights into academic performance in online learning environments.

The integration of deep learning into predictive models of academic performance has shown considerable potential for improving forecasting accuracy. Convolutional neural networks (CNNs) and recurrent neural networks (RNNs) have been particularly effective in extracting relevant features from online interactions, as shown by the research in (Li & Liu, 2021). Furthermore, moblizing deep neural networks to analyze online learning behaviors enables the identification of complex patterns tthan traditional methods can (Ghazvini et al., 2024). In this sense, (Deng et al., 2024) have emphasized the importance of integrating multidimensional models in education, showing how emotional, social, and cognitive intelligence can influence academic outcomes.

Thus, this literature review underscores a convergence towards recognizing the complexity of human intelligence and its direct impact on academic success, particularly in the context of online learning. By accounting for the multiple dimensions of intelligence, our research aims to develop a richer and more inclusive predictive model, capable of capturing the diversity of learning experiences and more accurately predicting the academic performance of learners in online learning platforms.

THE PROPOSED MODEL

Our model presents a systematic approach to predicting academic performance in an online learning environment. It is based on dynamic analysis of learners' skills development, integrating multiple data reflecting not only knowledge acquisition but also the evolution of specific and transferable competencies. As shown in Figure 2, the architecture of our online competency-based academic performance prediction model relies on a systematic and integrated approach designed to capture the complex interactions among learners, the online learning environment, and competencies development processes. Rooted in a learning environment, our model encompasses the various stages of this dynamic process. This learning environment is shaped by active pedagogical methods such as problem-based learning, project-based learning, among others, and is enriched by interaction with the teacher as well as the use of various disciplinary resources such as declarative, procedural, and conditional knowledge. Each learner starts their learning process with an initial skills profile and evolves by interacting with course activities, peers, and teachers.

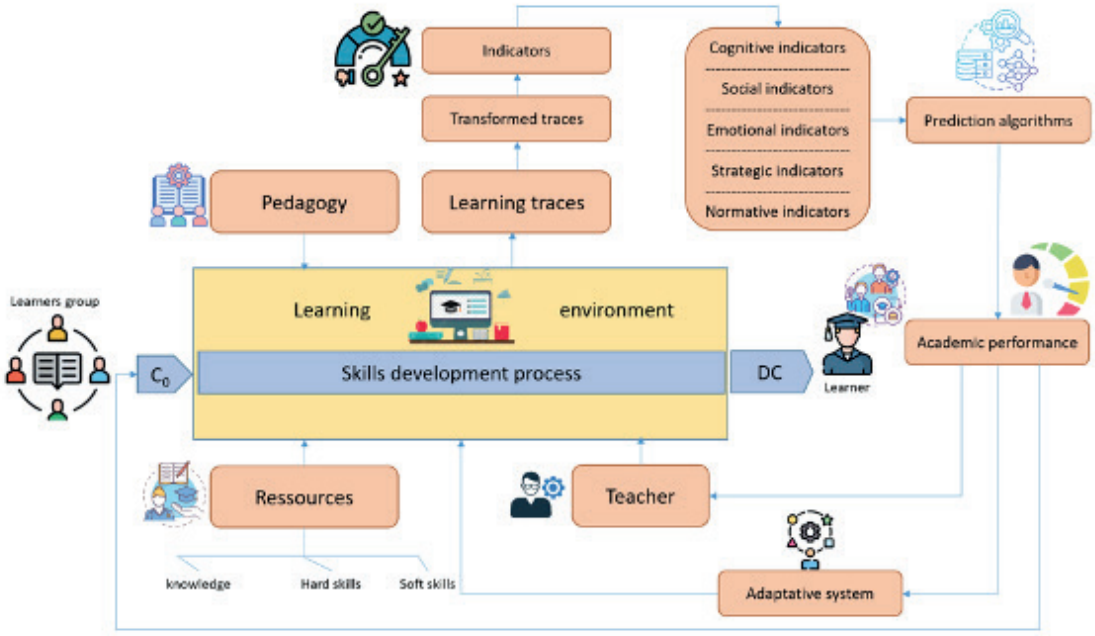

Figure 1. (APPMLT-CBT) Model for Academic Performance Prediction based on Competency-Based Learning Traces

The first step involves collecting learners' learning traces. These traces are then processed to extract various indicators representing cognitive, social, emotional, contextual, and normative aspects. These indicators serve as input data to a prediction system based on machine learning while using a hybrid approach. The output of this predictive system is the academic performance of each learner.

Competency-Based Learning as Pedagogical Framework

According to Franz E. Weinert, competence can be defined as an acquired cognitive disposition specific to demands, encompassing the knowledge, skills, and motivational attributions necessary to perform tasks and meet environmental requirements (Weinert, 2001). Consistent with De Landsheere Viviane, competence goes beyond the isolated application of cognitive, affective, or psychomotor abilities and involves an integrated combination of these different dimensions (Amraouy et al., 2022). In practice, several discrete abilities are combined into structures adapted to the contingencies of the situation. Competency-based learning is a pedagogical approach that emphasizes the practical application of knowledge and skills. Instead of focusing solely on theoretical knowledge, this approach aims to equip learners with the tools and abilities they need to solve problems, make decisions, and succeed in professional life, thus promoting their success in their careers (Bergsmann et al., 2015). By emphasizing competencies, this learning promotes a deeper understanding and practical application of concepts, preparing learners to face real-world challenges (Perrenoud, 1994). Furthermore, this approach encourages autonomy and responsibility by allowing learners to take charge of their own learning and progress at their own pace while developing essential skills such as critical thinking, collaboration, and problem-solving (Collazos, M. A., Hernandez, B., Molina, Z. C., & Ruiz, 2020). Through this approach, the learner develops the ability to mobilize internal resources (knowledge, skills, and attitudes) and external resources (dictionaries, books, media, etc.) to solve problems from the same family, thus reinforcing adaptability and overall competence (Moreira et al., 2023).

Online learning in the competency-based approach provides a flexible and adaptable platform, allowing learners to develop not only knowledge but also essential practical and cross-cutting skills. Through interactive tools, multimedia resources, and personalized assessments, learners can progress at their own pace, focusing on the skills they wish to acquire. Online learning also promotes autonomy and empowerment, encouraging learners to take ownership of their learning process and develop skills such as problem-solving, communication, and collaboration (Jacobs et al., 2023). Additionally, this approach allows for increased personalization by adapting content and activities to individual learners' needs and interests, thereby promoting more effective and motivating learning.

Competencies Development Process

Competencies development process begins at an initial stage designated by C0, where the targeted competency is in an embryonic state. This competency gradually develops through the dynamic interaction of multiple elements within the learning environment. Resources play a crucial role in this context, as they provide the necessary knowledge and expertise (hard skills) as well as interpersonal and behavioral skills (soft skills) that serve as the foundation for the developing skill. Furthermore, the tutor acts as a catalyst in this process. Their role is to guide, encourage, and adjust teaching methods and resources according to the specific needs of the learners, thereby facilitating the transformation of C0 into a developed and applicable competency DC. The tutor also plays a crucial role in interpreting learning traces and various indicators (cognitive, social, emotional, strategic, and normative) to tailor teaching to each individual. Ultimately, the acquired skill is assessed through the learner's academic performance, and the entire process is supported by adaptive systems that ensure the continuous optimization of learning.

Academic Performance

Academic performance refers to the assessment of a student's performance and outcomes within the educational context. It typically involves measuring a student's success in their studies, taking into account various criteria such as grades in courses, exam results, participation in academic activities, quality of work completed, progression in the courses, etc. Academic performance is often used as an indicator of competence and mastery of the knowledge and skills required in a specific field of study (Mason, 2017).

Prediction Algorithms

Academic performance prediction techniques constitute a valuable tool in the field of education, where a diverse range of statistical methods and machine learning models such as Random Forest (RF), Support Vector Machine (SVM), Artificial Neural Network (ANN), Logistic and Linear Regression (L/LR), Decision Tree (DT), Naïve Bayes (NB), K-Nearest Neighbor (KNN), ensemble/hybrid algorithms (Issah et al., 2023), (Saba Batool, Junaid Rashid, Muhammad Wasif Nisar, Jungeun Kim, 2023), as well as other analytical approaches, are utilized. According to the findings of research conducted by (Albreiki et al., 2021), among the algorithmic methods frequently used by researchers to assess student performance, Multiple Regression (MR), Artificial Neural Networks (ANN), Random Forest (RF), and hybrid algorithms are commonly employed.

The Multiple Regression Algorithm

Multiple regression is a statistical method used to model the relationship between a continuous dependent variable Y and multiple continuous independent variables X1, X2, ..., Xn. It employs a linear model to estimate the coefficients β1, β2, ..., βn, representing the impact of each independent variable on the dependent variable, according to the formula:

$$Y = \beta 0 + \beta 1\, X1 + \beta 2\, X2 + \ldots + \beta n\, Xn + \varepsilon$$

The parameters are estimated using techniques such as ordinary least squares (OLS), where the objective is to minimize the sum of squared residuals (errors) between the observed and predicted values of the dependent variable. The coefficients obtained are interpreted in terms of the variation of the dependent variable for each unit change in the corresponding independent variables.

The Random Forest Algorithm

Random Forest is a versatile machine learning algorithm used for classification and regression tasks. It is capable of handling both classification and regression problems. It operates by constructing an ensemble of many decision trees, with each tree trained on a random subset of the training data and features. Each decision tree in the forest provides an independent prediction. For a regression task, the predictions from individual trees are then aggregated to obtain a final prediction. Mathematically, the prediction process in Random Forest can be represented as follows:

$$\hat{Y} = \frac{1}{N}\sum_{i=1}^{n} f_i(X)$$

This translates to the average of predictions from each tree, where $\hat{Y}$ represents the final prediction, N is the total number of trees in the forest, and fi(X) is the prediction of tree i for the features X. The parameters of individual decision trees in Random Forest are adjusted to minimize a measure of error, such as the mean squared error for regression problems. Once trained, the forest of trees can be used to make predictions on new data with high accuracy and robustness.

The Artificial Neural Network Algorithm

Artificial neural networks are machine learning algorithms inspired by the functioning of the human brain. They consist of interconnected layers of neurons, with each connection having a weight determining its importance. Mathematically, the prediction process in a neural network can be represented as follows:

$$\hat{Y} = f(\sum_{i=1}^{n} W_i . X_i + b)$$

This formula shows how the input features Xi are weighted by the weights Wi, then summed and added to the bias b. The result is then passed through an activation function *f*, such as the sigmoid function, the Rectified Linear Unit (ReLU) function, or the hyperbolic tangent function, to obtain the final prediction $\hat{Y}$.

Hybrid Algorithms

The main challenge in prediction modeling lies in identifying effective techniques that can deliver acceptable prediction accuracy. To attain the utmost accuracy, numerous researchers have advocated for the use of hybrid techniques, which amalgamate multiple machine learning algorithms. Hybrid techniques entail combining various machine learning algorithms. Several studies, such as (Adejo & Connolly, 2018), (Saleem et al., 2021), (Yakubu & Abubakar, 2022), and (Niyogisubizo et al., 2022), have used hybrid algorithm techniques to assess at-risk students in a course and predict their success, thus demonstrating improved prediction accuracy.

The 5I

In this section, we explore the five intelligences (5I) that have a significant impact on learners' academic performance in online learning environments. These intelligences include cognitive, social, emotional, contextual, and normative intelligence. In the context of online learning, cognitive intelligence plays a crucial role in facilitating the understanding of concepts, problem-solving, and acquiring new knowledge through available digital resources (Otero et al., 2022). Similarly, social intelligence becomes essential for interacting with peers and teachers through online communication tools, thereby promoting collaboration and cooperative learning (Ramirez-mendoza et al., 2018). Emotional intelligence takes on particular importance in virtual environments, enabling learners to manage their emotions in the face of challenges and obstacles encountered in their online educational journey (Benesova et al., 2021), (MacCann, Carolyn Jiang, Yixin Brown, Luke E. R. Double, Kit S. Bucich, Micaela Minbashian, 2020). Contextual intelligence also becomes crucial as learners need to adapt their learning strategies to online teaching platforms and modalities while effectively utilizing available digital resources (Marishane, 2020). Finally, normative intelligence plays a role in adhering to academic standards and expectations in online learning, ensuring compliance with rules and policies established by educational institutions (Kier & Ives, 2022). By combining these five intelligences, learners are better equipped to succeed in online learning environments, leveraging technology opportunities to optimize their academic performance.

Digital Learning Traces

According to (Djouad et al., 2010), a Digital Learning Trace represents a sequence of observations collected from a Computer-Based Learning Environment (CBLE), also known as a trace source. These traces undergo various technical transformations, such as cleaning, rewriting, merging, and modeling, to generate new traces from which indicators can be extracted and utilized for Mirroring, Monitoring, or Guiding, as illustrated in Figure 1.

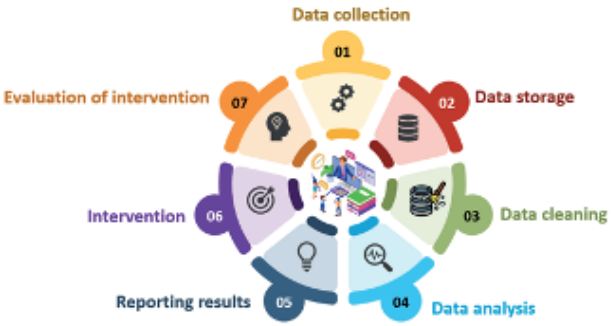

Figure 2. Lifecycle of Learning Traces

The processing of online learning traces, as illustrated in Figure 1, unfolds through several essential stages. Initially, it involves collecting data, which means gathering all user interactions with the educational platform, including qualitative data from learners such as responses to forms, tests, and obtained scores, as well as data collected from learner actions, such as explicit actions like platform logins, completed activities, help requests, participation in discussion forums, and resource allocation to learners, or implicit actions such as resource viewing time, inactivity time, and gestures. These pieces of information are subsequently recorded in a database in preparation for analysis. The third stage involves data cleaning, where errors and redundant data are removed. The purified data undergoes analysis to identify patterns and trends revealing individual learning dynamics. The results of this analysis are then summarized in a report that identifies the progress made as well as the strengths and weaknesses of the learner. This information serves as a foundation for the development of targeted interventions, such as personalized recommendations or modifications in pedagogical approach. The final phase involves evaluating the impact of these interventions and adjusting them as needed. This approach aims to provide effective support to the learner in their online learning experience, relying on concrete data to guide educational actions.

Academic Performance Prediction Approach

In this subsection, we consider key variables and characteristics, integrating the five intelligences as dimensions influencing learners' academic performance prediction, as well as factors of participation in discussion forums. The variables include previous standardized assessment results, learners' interactions with online educational resources, frequency and duration of learning sessions, level of participation in collaborative learning activities (Castillo et al., 2017), and demographic characteristics (YILDIZ & BOREKCI, 2020) such as age, gender, and socioeconomic status. Additionally, we examine specific factors associated with the five intelligences, as presented in the table 1.

Table 1. Grouping of traces collected by intelligence category

Category	Indicator	Meaning
Cognitive Intelligence	NW	The total number of words used in the posts of a learner on the forum.
	NC	The total number of characters used in the posts of a learner on the forum.
	NS	The total number of sentences used in the posts of a learner on the forum.
	TRC	Topic-relevant score counts the number of messages posted by a learner in discussion forums that are relevant to the course content.
Social Intelligence	NPD	Number of messages posted by each learner on the enriched discussion forum.
	NPR	Number of responses to other participants' messages posted by each learner on the forum.
	NV	The frequency with which other participants have viewed the content (posts) created by a learner.
Emotional Intelligence	ES	The emotional state expressed by each learner in their posts and comments on the enriched discussion forum.
Contextual Intelligence	FR	Frequency of consulting learning resources.
	EAR	Use of additional or external resources during learning sessions.
	RCP	Responsiveness to changes in content format or presentation.
	DEI	Level of engagement in collaborative activities.
	AC	Adaptability to challenges encountered in the learning process.
	CT	Overall connection time
Normative Intelligence	CRP	Compliance with institution's rules and policies.
	PA	Participation in academic activities.
	AI	Ability to follow instructions.
	TA	Time spent on specific activities related to content or topic.

The indicators were chosen based on their ability to capture different aspects of the five intelligences and their empirical relevance, validated by previous studies and exploratory tests in similar online learning environments. We chose forum interactions as key indicators because they provide rich and quantifiable data on learners' participation and engagement (Yang et al., 2022). These interactions capture not only the cognitive contribution through the relevance of messages but also the social and emotional dimensions by analyzing responses and peer interactions (Amraouy et al., 2020).

Cognitive intelligence is assessed through the calculation of the relevance score of messages. This is done by counting the number of relevant messages and comments posted by each learner in discussion forums. This approach allows for an objective evaluation of a learner's contribution to a given course. Latent semantic analysis (LSA) and machine learning methods used to classify forum messages based on their relevance to the course content (Yang et al., 2022). This approach provides insight into the degree of alignment of the learner's contributions with the course content, facilitating a more precise evaluation of their cognitive engagement.

To calculate the Social Intelligence Score (SIS), we use a formula that integrates the three indicators explained in Table 1: NPD, NPR, and NV. This formula, (NPD+NPR)×NV, takes into account both the quantity and quality of the learner's social interaction in the discussion forums. Therefore, it reflects both the active participation of the learner and the engagement of other participants with their content.

We adopt a similar approach to that of study (that explained in) (Rafiq et al., 2023) to evaluate emotional intelligence by analyzing the emotional state expressed in the messages. To do this, we mobilize the Bidirectional Encoder Representations from Transformers model (BERT) as a natural language processing techniques. The messages will be preprocessed to remove punctuation, convert them to lowercase, eliminate stop words, and normalize words. Then, we will apply a pretrained multilingual BERT model for sentiment analysis.

To calculate contextual intelligence we proposed the following formula:. $\frac{FR+EAR+RCP+DEI+AC}{CT \times k}$ First, FR is evaluated by counting the number of times a learner accesses available learning resources. Then, EAR is measured by observing interactions with sources external to the educational material. RCP is assessed by assigning numerical values to each level of responsiveness. DEI is evaluated by observing participation and contribution to group activities. AC is assessed by observing the learner's ability to overcome obstacles and adapt to new situations. Finally, CT is taken into account to reflect the learner's overall engagement in the learning process. The coefficient k represents a normalization factor that adjusts the relative importance of each indicator relative to the total connection time (CT). By adjusting k, we can ensure that each indicator contributes fairly to the overall measure of contextual intelligence, taking into account the total connection time of the learner. By normalizing these indicators in a global formula, we obtain an overall measure of the learner's contextual intelligence.

To calculate normative intelligence, we use the weighted average of its four indicators: CRP, PA, AI, and TA. Each of these indicators will be quantified based on the learner's behavior and engagement with institutional rules, academic activities, adherence to instructions, and allocation of time for content-related activities. This score aims to assess the extent to which the learner adheres to established norms and directives in the educational context, providing insights into their ability to navigate effectively within institutional expectations and requirements.

Finally, the learner's overall score is calculated using the weighted average of the scores of the 5I. Each score is weighted according to its relative importance in the context of online learning. This overall score is used to predict learner performance.

$$Score_{global} = w_1\ xScore_{cognitive} + w_2\ xScore_{social} + w_3\ xScore_{emotional} + w_4\ xScore_{contextal} + w_5\ xScore_{normative}$$

In addition to learning traces and demographic data, we collect other relevant information to enrich our model. This include data on learners' prior experience in the course subject area, their learning preferences, personal goals, and any other qualitative or quantitative data that could impact their academic performance.

DISCUSSION

In the competency-based approach, learners not only acquire knowledge but also develop the ability to use various resources to solve real-world problems. When using computerized environments, learning traces become essential for establishing this link with the skills developed. Nowadays, with the proliferation of online learning tools such as MOOCs, LMSs, Intelligent Tutoring Systems (ITSs), Adaptive Learning Systems (ALSs), and many others, collecting and analyzing learners' traces becomes a necessity to predict and assess their performance in a competency-focused educational context.

Also, In the context of competency-based learning, it is relevant to emphasize that learning traces are closely linked to dimensions of intelligence, as demonstrated in the study (Kashkool, 2023) and (Quilez-Robres et al., 2022). Cognitive intelligence, for example, is manifested through actions such as problem-solving and knowledge acquisition, playing a crucial role in academic development, as suggested also by the study (Onditi et al., 2022) and (Tikhomirova et al., 2020). Similarly, social intelligence is essential for building a collaborative and supportive learning environment by facilitating interactions with peers and teachers, as discussed in the study (Rafiq et al., 2023). Emotional intelligence, another crucial aspect, is necessary for overcoming emotional challenges associated with online learning, thereby promoting learners' motivation and engagement, a perspective also supported by the study (Rehman et al., 2017) and by (Amraouy et al., 2023). Furthermore, contextual intelligence, illustrated when learners adapt to the specifics of the learning context, demonstrates their ability to adapt and innovate, a notion also emphasized by the study (Buchler et al., 2021). Lastly, the importance of normative intelligence is highlighted in adherence to rules and academic expectations specific to virtual learning environments, thereby fostering cohesion and ethics within the educational community, a dimension that can be further explored considering the findings of study (Kier & Ives, 2022). These interconnected dimensions of intelligence underscore the complexity and richness of online learning, emphasizing the importance of proposing a model for predicting online learners' performance that integrates all these dimensions to promote a comprehensive and effective learning experience.

Our online academic performance prediction model is grounded in this systemic approach that integrates the cognitive, social, emotional, contextual, and normative intelligence. Regarding the contextual aspect, research (Goedl et al., 2024) revealed a strong and significant correlation between the number of videos watched by learners and their performance. In terms of the social dimension, (Rafiq et al., 2023) demonstrated that engagement in discussion forums was associated with higher scores and greater retention in MOOCs. Regarding the normative dimension. According to the findings of (Kier & Ives, 2022), adherence to academic norms and expectations is a crucial element of online learning, and compliance with rules and policies established by educational institutions is essential. As for the TA indicator, study (Rafiq et al., 2023) indicated that the consistency of accessing the learning platform and the time spent by learners on specific activities related to a given content or subject are strongly correlated with achieving good academic results. Additionally, the data analyzed in research (Jiang & Peng, 2023) included three types of activities (videos watched, assignments submitted, and messages written) as indicators of learner engagement in online tasks. The results of the learning analytics approach from (Jiang & Peng, 2023) showed that all three indicators (videos watched as contextual dimension, assignments submitted as cognitive dimension, and messages posted as social dimension) of engagement in online tasks significantly predicted academic performance, with scores on the final exam serving as a measure of their academic performance. It is noteworthy that the exploration of academic performance as a multidimensional concept is insufficient in the analyzed literature, highlighting the necessity for research aimed at enhancing the validity and reliability of measuring learners' intelligence and performance in online learning environments. To address this, we identified specific indicators associated with each intelligence dimension, such as the number of words, characters, and phrases used in learners' messages to assess their cognitive intelligence, as well as their participation and interactions in discussion forums to measure their social intelligence. Furthermore, we developed advanced analysis methods, utilizing the Bidirectional Encoder Representations from Transformers (BERT) model and Latent Semantic Analysis (LSA), to evaluate learners' emotional state and the relevance of their contributions. Moreover, we included measures of learners' engagement in online activities, their adaptability to challenges encountered, and their compliance with institutional rules to capture the contextual and normative dimensions of their intelligence. By integrating these different dimensions of intelligence, our model aims to provide an accurate and comprehensive prediction of online academic performance, considering the diversity of learners' abilities and skills in a digital learning environment.

Conclusion and Future Work

Education is undergoing a profound transformation with the advent of digital learning, particularly with the rise of online education. The intent of this paper is to develop a conceptual framework, APPMLT-CBT model, offering an approach to predicting and enhancing learners' academic performance in the online environment. The proposed model should be interest to both online learning environment and academic community. For online learning environment, the model will enhance leaners' experience by taking into account the cognitive, social, emotional, contextual, and normative intelligence. A proposed model also serves as a foundation for understanding competency-based online learning processes and offers ample research opportunities for the academic community to validate, either supporting or disproving the proposed propositions. In the future, we will improve our model by exploring new deep learning techniques and refining criteria for predictive performance evaluation. Additionally, we plan to expand our model to support personalized online learning, providing individualized pedagogical recommendations based on academic performance predictions.

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INVESTIGATING THE FUNCTIONALITY OF FLIPPED VIRTUAL CLASSROOM MODEL SUPPORTED BY MOBILE LEARNING ENVIRONMENTS IN CLASSICAL GUITAR EDUCATION

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ABSTRACT

The main objective of this current study is to present an example of how to use the flipped virtual classroom model supported by mobile learning environments in guitar education. Within the scope of this objective, this study aims to reveal how guitar teaching with the flipped virtual classroom model supported by mobile learning environments influences the students' performance skills and the achievement of the lesson outcomes. This research falls within the scope of emancipatory/developmental/critical action research among action research types. The study group of the research consists of 5 undergraduate guitar students. The study group of the research was determined by the typical case sampling method, which is one of the purposive sampling methods. The data collection tools of the study include demographic information forms, performance observation forms, unit evaluation forms, researcher and student diaries, video recordings of online lessons, mobile learning environment evaluation forms, application messages and student portfolios. According to the results of this study, it can be concluded that the guitar education conducted with the flipped virtual classroom model supported by mobile learning environments improved the performance of the students and contributed to their achievement of the program outcomes.

Keywords: Flipped virtual classroom, flipped learning, mobile learning, mobile application, guitar education, music education.

INTRODUCTION

In learning process, the learner needs to be active in order to encode the given information in a meaningful way and to use it when required in real life. Therefore, it is contrary to the nature of learning for the learner to be completely passive in the learning process. Effective learning is only possible when qualified learning environments are provided and learners who construct knowledge actively take part in the learning process. Today, many learning theories and approaches that are based on this approach enable students to construct knowledge. Actually, with the development of technology and the effect of its use in education, learning models

such as distance learning, web-based learning, and mobile learning, learning processes that are temporally and spatially alternative to formal education are preferred across various schools (Kuyumcu et al., 2021).

The mobile learning model, which is based on the use of mobile technologies in educational processes, is a contemporary learning model that eliminates time and space limitations (Ozan, 2013; Odamar Keskin, 2011; Tanriverdi 2011; Torun & Dargut, 2015 cited in Kuyumcu et al., 2021). This model can be used to support traditional education or to provide distance education. In this model, learning activities are carried out via smart mobile phones and table computers.

When the mobile devices in mobile learning are considered, we tend to think of reasonably sized devices that are not connected to any location and are not dependent on a power source. The reason for this is the space and time independence of mobile devices (Jason, 2007 cited in Agca, 2013).

Mobile learning offers opportunities such as time and space flexibility, equal opportunities, individualized learning, easy communication, low cost, etc. in education. From this point of view, the use of mobile learning model in music education will pedagogically contribute to music education processes. The use of mobile devices, computers, virtual environments, social platforms, platforms that allow listening to music and sharing it with others, and various software and applications like mobile tools in music education, which affect every aspect of our lives in our age, provides the opportunity to access information and use this information quickly as well as providing data diversity in music education processes.

Due to the nature of music, digital media are needed in many sub-dimensions of music education such as musical hearing (ear) education, voice education, instrument education, musical movement and rhythm (weighing) education. For example, voice recorders, note transcribers, music listeners, tuners and many other programs and software can meet the various needs of learners. Taking advantage of the convenience and functionality offered by technology can enrich music education in terms of the materials used and bring quality learning processes. In addition, since resources and course materials can be easily shared and used with the support of technology, in-class lesson time can be used more effectively, and virtual learning environments such as simulations, games, etc. can both increase students' motivation and provide permanent learning. Therefore, in today's world where the use of technology has become an obligation, the use of the mobile learning model based on the systematic use of technology in music and instrument education and the creation and implementation of music curricula based on this model will have a positive effect on learners' musical behavior acquisition.

Technological products in education are sometimes used as supporting materials in some contemporary learning models. Studies show that technological products are effective when integrated into teaching processes. (Torun & Dargut, 2015), One of these models is the flipped classroom model. In brief, the flipped classroom model can be defined as a model that offers students the opportunity to learn theoretical knowledge at home on their own and apply what they have learned in the classroom.

The flipped learning model can be briefly defined as a pedagogical approach that focuses on individual learning rather than group learning. The content in flipped learning which is presented with videos prepared by the teacher provides a more meaningful and richer learning environment for the time spent face-to-face in the classroom. In flipped learning, teaching is individualized. The content is presented with videos prepared by the teacher. The videos presented to students out of class create more meaningful and richer learning opportunities in face-to-face learning time with the teacher. This is actually what provides individualized learning. Many methods, variables, student-centered learning approaches, differentiated instruction, problem-based learning, project-based learning, inquiry learning and others are more practical when combined with flipped learning (Aydin & Demirer, 2015; Kara, 2016; Sams & Bergmann, 2012).

The popularity of flipped learning model has increased in the recent years and it is basically based on the idea that learning activities such as comprehension and recalling are carried out outside the classroom with the support of videos and various materials while high-level learning practices such as application, analysis, evaluation and production are carried out in the classroom (Mok, 2014).

The flipped classroom model is also referred as flipped learning and flipped classroom in the relevant literature. There are different types of this model such as the standard flipped classroom, discussion-oriented flipped classroom, demonstration-oriented flipped classroom, group-based flipped classroom, which are supported

by face-to-face lessons in the traditional classroom, as well as the virtual example of the flipped classroom where out-of-classroom activities are carried out online in a virtual learning environment.

The flipped classroom model offers many educational opportunities in the learning process. In this model, learners have opportunities such as time and space flexibility, direct learning, questioning, practicing, more active learning activities in class time, asking the teacher while reinforcing learning and receiving instant feedback from the teacher. Students can read and watch the course content over and over again through videos and various digital tools provided. From this point of view, the use of this contemporary learning model in music and instrument education can contribute to the learning experiences of music students. In this model, individualized learning comes to the fore. The individual takes the responsibility for his/her own learning and can organize variables such as time and space in the learning process.

Individual learning activities are significant in music and instrument education. In addition, in music and instrument education, which is mostly based on practice, the fact that students are with the teacher and their peers in the classroom in applying and reinforcing processes will contribute to the correct application and reinforcement of information. This is mainly because of the fact that the learners will be able to get instant feedback from both the teacher and their peers in this process.

The flipped classroom model brings some disadvantages such as the difficulty of controlling learners in the out-of-class learning process, the inability to track whether learners have done their tasks or to what extent they have done them, and learners who are inadequate in individual learning may be left alone in the process of learning knowledge. In the mobile learning model, there may be some problems due to the lack of face-to-face meetings that are needed from time to time. Educational processes carried out with the mobile learning model are mostly carried out within the scope of distance education. This situation causes learners not to benefit from the opportunities that face-to-face education offers. Integrating the flipped classroom and mobile learning models and supporting these two models with each other will minimize the difficulties of both models. In this way, it will be possible to experience a more qualified learning process.

The relevant literature suggests that there are few studies in music and instrument education regarding the flipped classroom model. In addition, it has been revealed that the studies are carried out by only giving videos and documents to the learners, without supporting them with technology-based learning models such as mobile learning. Supporting the learning processes in the flipped classroom model with mobile learning environments can ensure that the out-of-school processes of the learners are monitored and controlled by the teacher, and that the teacher and the learners are in contact during these processes.

The use of different models in education can enable the learning designers to construct a qualified learning process. As in other disciplines, the use of mobile learning and flipped learning models in music education and its sub-dimension, instrument education, will contribute to the learning experience of music students. Considering the importance of audio-visual technologies in music and instrument education, especially using technology-based mobile learning and flipped learning models will accelerate the acquisition of musical behaviors of learners.

The problem of this research is how to apply the flipped virtual classroom model supported by mobile learning environments in guitar education and how its effect will be. In line with this problem, it is desired to determine how guitar education using the related model affects students' performance skills and the achievement of the course objectives.

THE OBJECTIVE OF THE STUDY

The main objective of this study is to investigate the functionality of the flipped virtual classroom model supported by mobile learning environments in guitar education. In line with this general purpose, it is aimed to reveal how guitar teaching with the flipped virtual classroom model supported by mobile learning environments affects students' performance skills and the achievement of unit outcomes. In addition, it is also aimed to determine the views of the researcher and students regarding the application. Within the scope of these aims, the following questions were sought to be answered in the study;

1. How do student performances improve in guitar education carried out with a flipped virtual classroom model supported by mobile learning environments?
2. What is the status of students' achievement of unit outcomes in guitar education conducted with the flipped virtual classroom model supported by mobile learning environments?
3. What are the views of researchers and students on guitar education conducted with a flipped virtual classroom model supported by mobile learning environments?

This research is considered to be of original value in terms of using the flipped virtual classroom model supported by mobile learning environments in classical guitar education and there is no such study that has been conducted in this field before. Based on this idea, this is study is thought to;

- provide an original learning process in which the limitations of flipped virtual classroom model are minimized with mobile learning environments,
- provide an alternative method for guitar education.
- be important in terms of setting an example for the teaching of other instruments despite being specifically designed for guitar education

This study is limited to

- the undergraduate students in guitar education in Fine Arts Education/ Music Education Departments of Kastamonu, Mugla and Trakya Universities.
- the curriculum of the individual instrument education (guitar) course and the selected works/ etudes which were taken as the basis of the study.

In this study,

- the students worked regularly during the application process,
- the students expressed their views sincerely,
- the mobile tools used in this study was able to meet the needs of the students,
- the Internet connection and speed didn't hinder the research processes.

METHODOLOGY

This research is a study on the use of the flipped virtual classroom model supported by mobile learning environments in guitar education and it was designed as action research.

Action research is a research process in a real school or classroom setting with the aim of understanding and improving the quality of teaching or action. Action research is a systematic and organized method. It is a systematic and organized way because it allows teachers to observe their own practice or to describe a problem and the type of action that might accompany it. At the same time, action research is a type of research that is pre-planned, organized and can be shared with other people (Johnson, 2012). Buyukozturk et al. (2009) state that action research, which is one of the qualitative methods, is an important type of research that is considered among the professional competencies that today's teachers should have and requires people who are directly related to the situation to work as researchers.

Action research is a cyclical form of practice that takes place in the form of action planning, putting the plan into action, data collection and analysis, and reflection. These stages of action research do not have a linear structure; some stages can be removed, replaced or repeated if required (Mills, 2003 cited in Okmen 2020).

In this research, an action plan is designed for the use of the flipped virtual classroom model supported by mobile learning environments in guitar education. This action plan is aimed at improving guitar teaching. In this respect, the research falls within the scope of emancipatory/developmental/critical action research, one of the types of action research.

Participants

The study group of the research was determined by the typical case sampling method, which is one of the purposive sampling methods. Typical case sampling method requires determining a typical situation from a

large number of situations in the universe related to the research problem and collecting information through this sample. The main aim here is to select an average typical situation that is not unusual (Buyukozturk et al. 2009, p.90).

The study group of the research consists of a total of 5 guitar students, 2 students from Kastamonu University, Department of Fine Arts Education, Department of Music Education, 1 student from Mugla University, Department of Fine Arts Education, Department of Music Education, and 2 students from Trakya University, Department of Fine Arts Education, Department of Music Education, who are undergraduate students in the 2020-2021 academic year. The students in the study group of the research declared that they would like to participate in the study voluntarily. In this context, the participants filled out the participant consent form prepared by the researcher and submitted it to the researcher.

Two of the students in the research study group are the 1st grade, two in the 2nd grade and one in the 3rd grade. The study group of the research was not determined according to the grade levels of the students. In this respect, a mixed group was formed. While deciding the study group, information about the guitar proficiency levels of the students in the study group was obtained from the expert lecturers conducting the guitar lessons. In this context, meetings were organized by the monitoring committee of the action research and the researcher with the expert instructors conducting the courses of the students in the study group, and detailed information about the guitar proficiency levels of the students was obtained. In the following phase, the meetings were also held with the students to reinforce the knowledge obtained previously.

The study group was initially composed of 11 students; however, when the study was about to start, 6 students informed the researcher that they could not continue the study due to various personal reasons, although they had previously declared that they voluntarily participated in the study. Therefore, the application was carried out with 5 students.

Data Collection Tools

Within the scope of the research, the data collection tools that enable to obtain required data can be listed as follows:

1. Demographic Information Form
2. Performance Observation Form
3. Unit Evaluation Form
4. Researcher and Student Diaries
5. Video Recordings of Online Courses
6. Mobile Learning Environment Evaluation Form
7. Application Messages
8. Student Portfolios

Demographic Information Form

The demographic information form was developed by the researcher to obtain information about the study group, to evaluate the equivalence of the study group and to contribute to the implementation of the lesson plans.

Performance Observation Form

The performance observation form was developed by Senoglu Ozdemir (2019). After taking the necessary permissions, this observation form was used at the end of each unit during the implementation process to evaluate the performances of the study group. After the video recordings of the works and etudes played by the students were sent to 3 experts in the field of guitar education, the experts were asked to evaluate the students' performances using this observation form.

The performance observation form consists of two sub-dimensions: technical and musical. There are a total of 22 items in the form, 10 for the technical sub-dimension and 12 for the musical sub-dimension. The raters evaluate the performance by using the numbers '0, 1, 2, 3, 4' against each item. Accordingly, number 4 indicates the most successful performance and the number 0 indicates the most unsuccessful performance. Therefore, the score obtained from the performance observation form and performance success are directly proportional. The highest score that can be obtained from the performance observation form is 88 (eighty-eight) and the lowest score is 0 (zero).

Unit Evaluation Form

Unit evaluation form prepared by the researcher, covers all the learning outcomes of a unit. For each outcome, there are 5 boxes, one for each student in the study group. These boxes were filled in by the researcher using "+" (achieved) and "-" (not achieved) signs. While preparing this form, expert opinions were taken by the researcher from two researchers who are experts in the field. Necessary corrections were made in line with these comments. This process was repeated for each unit and the students' achievement of the unit outcomes was evaluated.

Researcher and Student Diaries

Throughout the research process, the researcher wrote a diary and took notes of his opinions and observations about the implementation process. These notes guided the researcher in planning his lessons throughout the research process. In addition, these notes were used as supportive data when analyzing students' opinions and evaluating their achievement of the unit outcomes. The researcher kept a diary for the entire process from 12.07.2021, the start date of the education process, to 05.10.2021, the end date of the implementation process. In these diaries, he took notes separately for each student.

The students were also asked to keep a diary every week during the research process. Necessary guidance was given for the students to write their feelings and thoughts about both the educational activities at home and the online lessons in detail in their diaries. In this regard, students were provided with guiding questions prepared by the researcher while writing their diaries. The data obtained were analyzed and both taken into account in the next action plan and put into the study report at the end of the study.

Video Recordings of the Online Lessons

The online lessons conducted within the scope of the study were recorded. These recordings were carefully watched every week and used while planning the following lessons. In addition, the researcher used these recordings to evaluate the students' achievement of the unit outcomes.

Mobile Learning Environment Evaluation Form

Mobile learning environment evaluation form was prepared by the researcher and consisted of fifteen questions, eight of which were closed-ended and seven of which were open-ended. While preparing this form, expert opinions were taken by the researcher from two researchers who are experts in the field. Necessary corrections were made in line with these comments. At the end of each unit, students assessed the mobile learning environment using this form. In this way, students' views on the mobile learning environment within the scope of the study were obtained. The data obtained were analyzed and used in the planning of the following lessons, and at the end of the study, these data were combined and presented in the study report.

Application Messages

The messages sent by the students to the researcher via mobile applications during at-home activities enabled communication between the researcher and the students. In addition, the researcher used these messages as a source of supporting data while analyzing the data related to the study.

Student Portfolios

While analyzing the data related to the research, the researcher utilized the assignments and studies prepared by the students as a source of supporting data.

Environment

The environment in which face-to-face online courses are conducted and the mobile learning environment in which out-of-school educational activities are conducted are described in detail.

Individual Online Lesson Environment

Within the scope of the study, one individual online lesson was conducted with all students for one hour each week. In the online lessons, activities that reinforced students' learning were carried out within the scope of the flipped virtual classroom model, and students were provided with the necessary feedback about what they learned. Online lessons were conducted with students via *Zoom* platform.

Mobile Learning Environment

In the study, out-of-school education processes carried out within the scope of the flipped virtual classroom were supported with mobile learning environments. The mobile learning environment of the study consists of an educational social network platform (Edmodo) and 13 mobile applications that students can benefit from. Nine of these mobile applications are related to music, and Edmodo and the remaining three applications are non-musical applications.

In the study, first of all, a virtual classroom environment was created on the Edmodo social network platform and students were added to this classroom. The information about how and for what purpose the mobile applications selected by considering the needs of the students would be used was explained to the students with a presentation at the beginning of the 12-week implementation process. Information about the mobile applications to be used was also shared in the virtual classroom environment with their links so that students could download them onto their devices. In addition, two videos on the use of Edmodo were shared with the students so that they could use the virtual classroom environment, Edmodo, effectively. Then, resources and course content (pdf, word, video, and visuals) that students may need were shared with students in this platform. Within the scope of the course, all the activities that the students did at home were followed by the researcher in the mobile environment. In particular, instant communication was provided through the *WhatsApp* group to which the whole study group was added and it was also helpful for individual communication from time to time. The researcher shared his announcements to the students both through Edmodo and the *WhatsApp* group.

Within the scope of the study, *rhythm engineer lite, notate me, muse score, music dictionary, basic music information, music speed changer, metronome beats, datuner* and *spotify* were used as music-related applications/software; *edmodo, whatsapp messenger, translator* and *cam scanner* were used as non-musical applications/software.

Action Research Monitoring Committee

In this study, the researcher is the executor of the action plans by actively participating in the process. However, the monitoring committee of the action research followed the process in determining and executing the action plans, analyzing the data, and taking precautions against the problems experienced during the process, and guided the research.

The monitoring committee of this action research consists of two expert faculty members who are also the advisors of the thesis.

Implementation Process

In the study, an action plan covering the whole implementation process was prepared by the researcher. This plan could be revised during the process. Within the scope of the action plan of the study, a guitar lesson curriculum that can be conducted using a flipped virtual classroom model supported by mobile learning environments was prepared to be used in guitar education. This plan served as the general action plan of the research.

Before starting the development of the program, the researcher and two faculty members who are experts in the field examined the outcomes of the individual instrument (guitar) course of the music teaching undergraduate program prepared by the Council of Higher Education (YOK), and the outcomes that the students were expected to achieve within the scope of this study were determined. Then, 3 works and 1 etude covering these outcomes were selected from the guitar teaching repertoire. Each of these works and etudes was organized within the framework of a unit plan and a total of four units were created. The units include all the activities that the learner will do at home within the scope of the flipped virtual classroom model and all the learning activities to be carried out in the online course. The implementation process of the research was planned to be twelve weeks.

Prior to the beginning of the implementation of the study, the researcher and the members of the monitoring committee of the action research held meetings with the guitar instructors at the universities where the students in the study group were located and with the students in the study group, which was 11 people at the beginning. In these meetings, the students were informed about the whole study process. In addition, the students were also consulted about the start date of the implementation and their opinions were taken into consideration when determining the start date of the implementation. After all these processes, it was decided to conduct the research in the summer semester of the 2020-2021 academic year. On the start date of the implementation, 6 students in the study group stated that they could not participate in the implementation process for various reasons, and therefore the study group completed the implementation process with 5 students.

A comprehensive presentation was made by the researcher to the students about the implementation process and the use of the applications to be used in this context before the process of implementation started. Afterwards, students were added to the virtual guitar class in the Edmodo platform. During the implementation process, materials and resources related to the course as well as the forms sent to the students for data collection were shared on this platform. This platform was also used from time to time to make announcements and communicate with students. Later on, within the scope of the mobile learning environment of the study, the researcher established a *WhatsApp* group to which the study group was added. During the implementation process, instant communication and correspondence with the students were generally made through this platform. During the process, communication with the students was provided both from this group and through individual *WhatsApp* messages.

The implementation process of the twelve-week study started on 12.07.2021 and ended on 05.10.2021. In the study, the researcher had a participatory, reflective role and actively participated in the process. In this process, the researcher conducted the lessons.

In the implementation process, the first action plan was initially conducted for 6 weeks. Two units were covered in the first action plan, and the data obtained at the end of the action plan were evaluated and used in the preparation and implementation of the next action plan. During this process, both the problems experienced and the data obtained were shared by the researcher with the monitoring committee of the action research, and decisions regarding the research were taken in collaboration.

The data obtained from the first action plan showed that there was no need to make comprehensive changes in the curriculum. Nevertheless, measures were taken to address the difficulties expressed by the students and thus the second action plan was initiated. The second action plan was implemented for 3 weeks and one unit was covered in this action plan. The data obtained at the end of three weeks were re-evaluated. When the data obtained were evaluated, the third action plan was not needed, the remaining unit was added to the second action plan and the 12-week implementation process was completed. All the processes of the study were completed in 12 months. The work/time schedule of the study is presented in Table 1.

Table 1. Work/Time Schedule

	Work Done	Months		
		1	2	3
1	Literature review	X		
2	Establishing the program		X	
3	Identifying the data collection tools and the study group		X	
4	Data collection and implementation process			X
5	Data analysis		X	
6	Writing the thesis		X	

Data Collection

The data for the first sub-objective of the study were obtained from the performance observation form. One piece for three units of the curriculum and one etude for one unit were studied. At the end of each unit, the students recorded the piece/ etude they learned within the scope of the unit using a video camera and sent it to the researcher. The researcher sent these videos to three faculty members who are experts in the field of guitar education to evaluate the students' performances. The experts used a previously developed performance observation form to evaluate these performances.

The data for the second sub-objective of the study were obtained from the unit evaluation form. In this regard, the students' achievement of the cognitive, affective and kinesthetic outcomes of the unit was examined. Using the unit evaluation form prepared by the researcher, the students' realization of the unit outcomes was evaluated.

The data for the third and the last sub-objective of the study were obtained from the diaries and the mobile learning environment evaluation form. The researcher kept a diary throughout the whole process. He took notes about each student separately in these diaries. Throughout the research, students also wrote their feelings and thoughts about the whole education process in their diaries every week. In order to obtain detailed student opinions about each stage of the research, the researcher asked the students to benefit from some guiding questions he prepared while they are writing their diaries.

In the study, students were asked to assess the mobile learning environment. For this purpose, the researcher prepared a mobile learning environment evaluation form and asked the students to evaluate the mobile learning environment by using this form at the end of each unit. This form consisted of fifteen questions, eight of which were closed-ended and seven of which were open-ended. Each student evaluated the mobile learning environment four times using this form. The purpose of the students' re-evaluation of the same environment at the end of each unit was to check the functionality of this environment separately for four units consisting of different contents. However, students generally responded in the same direction. Therefore, although these data were analyzed separately at the end of each unit, they were combined and presented at a unified manner in order to avoid repeating the same data over and over again in the findings of the study.

Data Analysis

Within the scope of the first sub-objective of the study, the average of the total scores obtained by the students with the evaluations of three different faculty members who are experts in the field was calculated and this score was accepted as the success score obtained by the students. Cut-off points were created to evaluate the success status of the students. Accordingly, students with 0-22 points were considered unsuccessful, students with 23-44 points were considered average, students with 45-66 points were considered successful, and students with 67-88 points were considered very successful.

For the second sub-objective of the study, the data obtained from the unit evaluation form were analyzed. This form, prepared by the researcher, covers all the learning outcomes of each unit. There are 5 boxes opposite each outcome, one for each student in the study group. These boxes were filled in by the researcher using "+" (achieved) and "-" (not achieved) signs. The researcher evaluated the students' achievement of the unit outcomes by examining the video recordings of the online lessons, student diaries, researcher's diary and students' performance records. This process was repeated for each unit.

In the third and final sub-objective of the study, the diaries were subjected to content analysis. Within the extent of the students' views on the mobile learning environment, closed-ended questions in the mobile learning environment evaluation form were subjected to percentage frequency calculation and open-ended questions were subjected to content analysis.

The content analysis was conducted using *NVivo* data analysis program. The raw data were uploaded to the program and then codes and themes were created from these data. These themes were evaluated by quoting from the answers given by the students.

Validity and Reliability of the Study

The data in this study were analyzed through qualitative methods. Regarding validity in qualitative research, Yildirim and Simsek (2013) mention two sub-elements of validity. These are called credibility (internal validity) and transferability (external validity).

In the validity study of this research, every stage of the study from the beginning to the end study explained in detail for the credibility (internal validity) sub-dimension of validity was. In the process, expert opinions were taken both when determining the data collection tools and when evaluating the data, and the expert opinions received contributed to the quality of the study. For the transferability (external validity) sub-dimension of validity; the research model, study group, data collection tools, data collection process, data analysis and organization of the findings were explained in detail. The data were organized in a way that other researchers could easily understand.

Reliability in qualitative research is ensured by consistency (internal reliability) and confirmability (external reliability). The internal reliability (consistency) of this study was achieved. In this context, since the beginning of the study, all processes of the study such as the preparation of the curriculum, determination of data collection tools, planning and execution of the implementation process were observed by both thesis advisors and jury members in the thesis monitoring committees. Thus, the consistency of the researcher was examined. In addition, the codes and themes created within the scope of content analysis were examined by two expert faculty members by comparing them with the raw data. In addition, the monitoring committee of the action research was involved in the process while generating findings for all sub-objectives

In order to ensure the external reliability (confirmability) of the research, detailed explanations about the basic stages of the study were listed and the raw data obtained from the research were kept in order to make comparisons with other similar studies in the future.

In addition to these, while analyzing the findings, direct quotations were made from the students' opinions to contribute to the validity and reliability of the research. When quoting from the students, the students were indicated as S1-S2-S3-S3-S4-S5. In the study, the initials of the students' names were listed alphabetically and the students were numbered from 1 to 5.

Within the scope of another reliability study of the research, the coefficient of concordance of the ratings of 3 field experts who evaluated the student performances obtained for the first sub-objective was examined. In this context, the Krippendorff Alpha reliability coefficient of the field experts was calculated using the SPSS data analysis program. Krippendorff Alpha statistic (Krippendorff, 1995. cited in Bikmaz Bilgen and Dogan) was first developed to determine the measure of agreement between coders in content analysis. As a concordance statistic, it is also used to determine the agreement between raters. The value ranges for the interpretation of the Krippendorff's Alpha coefficient are <0.67 Poor 0.67 - 0.80 Medium 0.80 - 1.00 High. The Krippendorff Alpha coefficient of concordance of 3 field experts who evaluated the performances within the scope of the study is presented in Table 2.

Table 2. Krippendorff Alpha Coefficient of Concordance

Unit Performances	Krippendorff Alpha Reliability Estimation					
	Alpha	LL95%CI	UL95%CI	Units	Observers	Pairs
Unit 1 Performance	0,8436	0,7683	0,9068	5.0000	3.0000	15.0000
Unit 2 Performance	0,6909	0,4496	0,8923	5.0000	3.0000	15.0000
Unit 3 Performance	0,6901	0,5344	0,8256	5.0000	3.0000	15.0000
Unit 4 Performance	0,2689	-0,1874	0,6680	5.0000	3.0000	15.0000

When Table 2 is examined, the coefficient of concordance for Unit 1 performance evaluations of 3 field expert raters according to the reference intervals of Krippendorff Alpha coefficient of concordance is high, the coefficients of concordance for Unit 2 and 3 performance evaluations are moderate, and the coefficient of concordance for Unit 4 performance evaluations is weak.

In the light of these data, it can be stated that the raters gave scores close to each other for the student performances of the first, second and third units within the scope of the study. However, it is evident that the raters did not give close scores for the student performances of the fourth unit. The work of the fourth unit is a work in Soleares form in the Flemenco genre, which has many different technical features from the guitar education repertoire and is widely used. It can be thought that this piece may cause variations in the performance evaluations of the raters due to the fact that they have different expectations.

FINDINGS

In this section, the findings obtained for the sub-objectives of the study are presented.

Findings Related to the Sub-Objective 'How Do Student Performances Improve in Guitar Education Conducted with A Flipped Virtual Classroom Model Supported by Mobile Learning Environments?'

Findings Related to the Unit 'Performing Prelude No I'

The success of the students in the performance evaluation of Prelude No 1, which they learned in the first unit of the curriculum, is presented in Table 3.

Table 3. Student Performances in Prelude No I

Students	S1	S2	S3	S4	S5
Student Performance	Average	Very successful	Successful	Very successful	Successful

Regarding the success of the students in Prelude No I, Table 3 indicates that there were no unsuccessful students, two students were very successful, two students were successful and one student was average.

Findings Related to the Unit of 'Performing of Askaroz Deresi'

The success of the students in the performance evaluation of the piece named Askaroz Deresi, which they studied in the second unit of the curriculum, is presented in Table 4.

Table 4. Student Performances in Askaroz Deresi

Students	S1	S2	S3	S4	S5
Student Performance	Successful	Very successful	Successful	Very successful	Successful

Examining Table 4, it is observed that there are no unsuccessful and average students, two students are very successful and three students are successful regarding the performance status of the students for the piece titled Askaroz Deresi.

Findings Related to the Unit 'Performing Gangi Study No I'

Table 5 presents the students' performance evaluations of Gangi Study No I, which they learned in the third unit of the curriculum.

Table 5. Student Performances in Gangi Study No I

Students	S1	S2	S3	S4	S5
Student Performance	Successful	Very successful	Very successful	Very successful	Very successful

As can be seen in Table 5, it is revealed that there are no unsuccessful and average students, four students are very successful and one student is successful in Gangi Study No I.

Findings Related to the Unit of 'Performing Soleares'

The performance evaluations of Soleares, which the students studied in the fourth unit of the curriculum, are presented in Table 6.

Table 6. Student Performances in Solearas

Students	S1	S2	S3	S4	S5
Student Performance	Average	Very successful	Very successful	Very successful	Successful

According to Table 6, it is found that there were no unsuccessful students, three students were very successful, one student was successful and one student was average in terms of students' performance in Soleares.

Based on these findings, students' performance in all units is presented in Table 7.

Table 7. Student Performances in All Units

Unit Perfomances	**Students**				
	S1	S2	S3	S4	S5
Unit 1	Average	Very successful	Successful	Very successful	Successful
Unit 2	Successful	Very successful	Successful	Very successful	Successful
Unit 3	Successful	Very successful	Very successful	Very successful	Very successful
Unit 4	Average	Very successful	Very successful	Very successful	Successful

When Table 7 is analyzed, according to the evaluations of three field expert faculty members, regarding the achievement of the students for all units can be summarized as follows;

- S2 and S4's performance achievement for all units was very successful,
- S1's performance achievement level for the first and fourth units was average, while his performance achievement level for the second and third units was successful,
- S3's performance achievement for the first and second units was successful, and her performance achievement for the third and fourth units was very successful,
- It is seen that S5's performance achievement status for the first, second and fourth units was successful and his performance achievement status for the third unit was very successful.

In the light of these findings, it can be concluded that the students' performance achievement for the units was not unsuccessful, and although only one student's achievement for the first and fourth units was average, the students' achievement for the unit performances was successful and very successful.

Findings Related to the Sub-Objective 'How Are the Students' Realization of The Unit Outcomes in Guitar Education Carried Out with The Flipped Virtual Classroom Model Supported by Mobile Learning Environments?

Findings Related to the Unit 'Performing Prelude No I'

This unit, which is the first unit of the curriculum, has 14 cognitive, 12 affective and 7 kinesthetic domain outcomes. The students' realization of the cognitive domain outcomes of the unit is presented in Table 8, the students' realization of the affective domain outcomes is presented in Table 9, and the students' realization of the cognitive domain outcomes is presented in Table 10.

Table 8. Students 'Achievement of the Cognitive Domain Outcomes of the Unit 'Performing Prelude No I'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Cognitive Domain Outcomes	1	*Tells/writes the basic concepts related to tone.*	+	+	+	+	+
	2	*Tells/writes the principles related to tone.*	+	+	+	+	+
	3	*Tells/writes the basic concepts related to F sharp minor scale.*	+	+	+	+	+
	4	*Tells/writes the principles related to the F sharp minor scale.*	+	+	+	+	+
	5	*Tells/writes the basic concepts related to the A major scale.*	+	+	+	+	+
	6	*Tells/writes the principles related to the A major scale.*	+	+	+	+	+
	7	*Tells/writes the basic concepts related to the prelude form.*	+	+	+	+	+
	8	*Tells/writes the principles related to the prelude form.*	+	+	+	+	+
	9	*Tells/writes information about the composer and period of Prelude No I.*	+	+	+	+	+
	10	*Tells/writes information about the rhythmic and harmonic structure of Prelude No I.*	-	+	-	+	-
	11	*Tells/writes the basic concepts of apoyando, tirando, arpeggio and legato.*	+	+	+	+	+
	12	*Tells/writes the principles of apoyando, tirando, arpeggio and legato.*	+	+	+	+	+
	13	*Tells/writes the basic concepts related to the musical expressions in Prelude No I.*	+	+	+	+	+
	14	*Tells/writes the principles related to musical expressions in Prelude No I.*	+	+	+	+	+
		Total Outcomes Achieved	**13**	**14**	**13**	**14**	**13**

According to Table 8, it can be asserted that S2 and S4 realized all the cognitive domain outcomes of the unit. However, it is seen that S1, S2 and S3 could not realize one cognitive domain outcome of the unit, and this outcome is the outcome of telling/writing information about the rhythmic and harmonic structure of Prelude No I.

Table 9. Students' Achievement of the Affective Domain Outcomes of the Unit 'Performing Prelude No I'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Affective Domain Outcomes	1	*Is attentive to practicing/performing the F sharp minor scale in learning environments*	+	+	+	+	+
	2	*Is willing to practice/perform the F sharp minor scale in learning environments.*	+	+	+	+	+
	3	*Is attentive to practicing / performing the A major scale in learning environments.*	+	+	+	+	+
	4	*Is willing to practice / perform the A major scale in learning environments.*	+	+	+	+	+
	5	*Is attentive to practicing/performing the F sharp minor arpeggio exercise.*	+	+	+	+	+
	6	*Is willing to practice/perform the F sharp minor arpeggio exercise.*	+	+	+	+	+
	7	*Is attentive to practicing/performing the A major arpeggio exercise.*	+	+	+	+	+
	8	*Is willing to practice/perform the A major arpeggio exercise.*	+	+	+	+	+
	9	*Is attentive to practicing/performing the Prelude No I.*	+	+	+	+	+
	10	*Is willing to practice/perform the Prelude No I.*	+	+	+	+	+
	11	*Is attentive to practicing/performing the musical expressions in the piece.*	+	+	+	+	+
	12	*Is willing to practice/perform the musical expressions in the piece.*	+	+	+	+	+
		Total Outcomes Achieved	**12**	**12**	**12**	**12**	**12**

Examining Table 9, regarding the students' achievement of the affective domain outcomes of the unit, it is seen that all five students in the study group achieved all the affective domain outcomes of the unit.

Table 10. Students' Achievement of the Kinesthetic Domain Outcomes of the Unit '*Performing Prelude No I*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Kinesthetic Domain Outcomes	1	*Performs the F sharp (melodic) minor scale in three octaves on the guitar.*	+	+	+	+	+
	2	*Performs the A major scale in three octaves on the guitar.*	+	+	+	+	+
	3	*Performs apoyando, tirando, arpeggio and legato techniques on guitar.*	+	+	+	+	+
	4	*Performs the F sharp minor arpeggio exercise on the guitar.*	+	+	+	+	+
	5	*Performs the A major arpeggio exercise on the guitar.*	+	+	+	+	+
	6	*Performs Prelude No I at the desired level.*	-	+	+	+	+
	7	*Performs the musical expressions in the piece at the desired level.*	-	+	+	+	-
		Total Outcomes Achieved	**6**	**7**	**7**	**7**	**6**

When Table 10 is examined, it can be concluded that S2, S3 and S4 achieved all the kinesthetic domain outcomes of the unit in terms of students' achievement of the kinesthetic domain outcomes of the unit. However, it is seen that S1 could not realize two kinesthetic domain outcomes of the unit, these outcomes were 'Performs Prelude No I at the desired level' and 'Performs the musical expressions in the piece at the desired level', and S5 could not realize one kinesthetic domain outcome of the unit, this outcome was 'Performs the musical expressions in the piece at the desired level'.

In the light of these findings, it can be asserted that the students realized most of the cognitive affective and kinesthetic domain outcomes of the unit 'Performing Prelude No I'.

Findings Related to the Unit of 'Performing Askaroz Deresi'

As the second unit of the curriculum, this unit has 13 cognitive, 12 affective and 6 kinesthetic domain outcomes. The students' achievement of the cognitive domain outcomes of the unit is presented in Table 11, the students' achievement of the affective domain outcomes is presented in Table 12 and the students' achievement of the kinesthetic domain outcomes is presented in Table 13.

Table 11. Students' Achievement of the Cognitive Domain Outcomes of the Unit '*Performing Askaroz Deresi*"

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Cognitive Domain Outcomes	1	*Tells/writes the basic concepts related to the B minor scale.*	+	+	+	+	+
	2	*Tells/writes the principles related to the B minor scale.*	+	+	+	+	+
	3	*Tells/writes the basic concepts related to the D major scale.*	+	+	+	+	+
	4	*Tells/writes the principles related to the D major scale.*	+	+	+	+	+
	5	*Tells / writes the basic concepts related to the concept of folk song.*	+	+	+	+	+
	6	*Tells / writes the principles related to the concept of folk song.*	+	+	+	+	+
	7	*Tells / writes information about the work named Askaroz Deresi.*	+	+	+	+	+
	8	*Tells/writes information about the composer of the piece named Askaroz Deresi..*	+	+	+	+	+
	9	*Tells / writes information about the rhythmic and harmonic structure of the piece named Askaroz Deresi.*	-	+	+	+	+
	10	*Tells / writes the basic concepts of baring and ornamentation techniques.*	+	+	+	+	+
	11	*Tells / writes the principles of baring and ornamentation techniques.*	+	+	+	+	+
	12	*Tells / writes the basic concepts related to the musical expressions of Askaroz Deresi.*	+	+	+	+	+
	13	*Tells/writes the principles related to the musical expressions in Askaroz Deresi.*	+	+	+	+	+
		Total Outcomes Achieved	**12**	**13**	**12**	**13**	**12**

Regarding the students' realization of the cognitive domain outcomes of the unit, when Table 11 is examined, it can be stated that all students except T1 realized all the outcomes of the unit. However, it is seen that S1 could not realize one cognitive domain outcome of the unit, and this outcome is the outcome titled "tells/ writes information about the rhythmic and harmonic structure of the piece named Askaroz Deresi".

Table 12. Students' Achievement of the Affective Domain Outcomes of the Unit '*Performing Askaroz Deresi*"

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Affective Domain Outcomes	1	*Is attentive to practicing/performing the C minor scale in learning environments.*	+	+	+	+	+
	2	*Is willing to practice/perform the C minor scale in learning environments.*	+	+	+	+	+
	3	*Is attentive to practicing / performing the D major scale in learning environments.*	+	+	+	+	+
	4	*Is willing to practice / perform the D major scale in learning environments.*	+	+	+	+	+
	5	*Is attentive to practicing/performing the B minor arpeggio exercise.*	+	+	+	+	+
	6	*Is willing to practice/perform the B minor arpeggio exercise.*	+	+	+	+	+
	7	*Is attentive to practicing/performing the D major arpeggio exercise.*	+	+	+	+	+
	8	*Is willing to practice/perform the D major arpeggio exercise.*	+	+	+	+	+
	9	*Is attentive to practicing/performing the piece titled Askaroz Deresi.*	+	+	+	+	+
	10	*Is willing to practice/perform the piece titled Askaroz Deresi.*	+	+	+	+	+
	11	*Is attentive to practicing/performing the musical expressions in the piece.*	+	+	+	+	+
	12	*Is willing to practice/perform the musical expressions in the piece.*	+	+	+	+	+
		Total Outcomes Achieved	**12**	**12**	**12**	**12**	**12**

When Table 12 is examined, it is clearly seen that all five students in the study group achieved all the affective domain outcomes of the unit.

Table 13. Students' Achievement of the Kinesthetic Domain Outcomes of the Unit '*Performing Askaroz Deresi*"

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Kinesthetic Domain Outcomes	1	*Performs the B (melodic) minor scale in three octaves on the guitar.*	+	+	+	+	+
	2	*Performs the D major scale in two and three octaves on the guitar.*	+	+	+	+	+
	3	*Performs baring and ornamentation techniques on guitar.*	+	+	+	+	+
	4	*Performs exercises prepared for baring and ornamentation techniques.*	+	+	+	+	+
	5	*Performs the piece named Askaroz Deresi at the desired level.*	+	+	+	+	+
	6	*Performs the musical expressions in the piece at the desired level.*	-	+	+	+	+
		Total Outcomes Achieved	**4**	**6**	**6**	**6**	**5**

According to Table 13, regarding the students' realization of the unit's cognitive domain outcomes, it is seen that all students except S1 realized all the outcomes of the unit, S1 could not realize one cognitive domain outcome of the unit, and this outcome was the outcome of " Performs the musical expressions in the piece at the desired level".

In the light of these findings, it can be argued that the students realized almost all of the cognitive affective and kinesthetic domain outcomes of the unit 'Performing Askaroz Deresi'.

Findings Related to the Unit 'Performing M. Gangi Study No I Etude'

This unit, which is the third unit of the curriculum, has 13 cognitive, 13 affective and 7 kinesthetic domain outcomes. The students' achievement of the cognitive domain outcomes of the unit is presented in Table 14, the students' achievement of the affective domain outcomes is presented in Table 15 and the students' achievement of the kinesthetic domain outcomes is presented in Table 16.

Table 14. Students' Achievement of the Cognitive Domain Outcomes of the Unit '*M. Gangi Study No I*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Cognitive Domain Outcomes	1	*Tells/writes the basic concepts related to the A minor scale.*	+	+	+	+	+
	2	*Tells/writes the principles related to the A minor scale.*	+	+	+	+	+
	3	*Tells/writes the basic concepts related to C major scale.*	+	+	+	+	+
	4	*Tells/writes the principles related to the C major scale.*	+	+	+	+	+
	5	*Tells/writes the basic concepts related to the concept of etude.*	+	+	+	+	+
	6	*Tells/writes the principles related to the concept of etude.*	+	+	+	+	+
	7	*Tells/writes information about the period of the etude named Study No I.*	+	+	+	+	+
	8	*Tells/writes information about the composer of the etude named Study No I.*	+	+	+	+	+
	9	*Tells/writes information about the rhythmic and harmonic structure of the etude named Study No I.*	-	+	-	+	+
	10	*Tells / writes the basic concepts of barre and ornamentation techniques.*	+	+	+	+	+
	11	*Tells / writes the principles of barre and ornamentation techniques.*	+	+	+	+	+
	12	*Tells/writes the basic concepts related to the musical expressions in the etude named Study No I.*	+	+	+	+	+
	13	*Tells/writes the principles related to the musical expressions in the etude named Study No I.*	+	+	+	+	+
		Total Outcomes Achieved	**12**	**13**	**12**	**13**	**13**

Regarding the students' realization of the cognitive domain outcomes of the unit, it is seen that S2, S4 and S5 realized all the outcomes of the unit, whereas S1 and S3 could not realize one cognitive domain outcome of the unit, and this outcome was the outcome of " tells/writes the information about the rhythmic and harmonic structure of the etude named Study No I".

Table 15. Students' Achievement of the Affective Domain Outcomes of the Unit '*M. Gangi Study No I*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Affective Domain Outcomes	1	*Is attentive to practicing/performing the scale in A minor.*	+	+	+	+	+
	2	*Is willing to practice/perform the scale in A minor.*	+	+	+	+	+
	3	*Is attentive to practicing/performing the scale in C major.*	+	+	+	+	+
	4	*Is willing to practice/perform the scale in C major.*	+	+	+	+	+
	5	*Is attentive to practicing/performing the A minor arpeggio exercise.*	+	+	+	+	+
	6	*Is willing to practice/perform the A minor arpeggio exercise.*	+	+	+	+	+
	7	*Is attentive to practicing/performing the C major arpeggio exercise.*	+	+	+	+	+
	8	*Is willing to practice/perform the C major arpeggio exercise.*	+	+	+	+	+
	9	*Is attentive to practicing/performing barre and ornamentation techniques.*	+	+	+	+	+
	10	*Is attentive to practicing/performing Study No I.*	+	+	+	+	+
	11	*Is willing to practice/perform Study No I.*	+	+	+	+	+
	12	*Is attentive to practicing / performing the musical expressions in the etude.*	+	+	+	+	+
	13	*Is willing to practice / perform the musical expressions in the etude.*	+	+	+	+	+
		Total Outcomes Achieved	**13**	**13**	**13**	**13**	**13**

When Table 15 is examined, it is seen that all five students in the study group realized all the affective domain outcomes of the unit.

Table 16. Students' Achievement of the Kinesthetic Domain Outcomes of the Unit '*M. Gangi Study No I*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Kinesthetic Domain Outcomes	1	*Performs the A (melodic) minor scale in three octaves on the guitar.*	+	+	+	+	+
	2	*Performs the C major scale in three octaves on the guitar.*	+	+	+	+	+
	3	*Performs barre and ornamentation techniques on guitar.*	+	+	+	+	+
	4	*Performs the A minor arpeggio exercise on the guitar.*	+	+	+	+	+
	5	*Performs the C major arpeggio exercise on the guitar.*	+	+	+	+	+
	6	*Performs Study No I at the desired level.*	+	+	+	+	+
	7	*Performs the musical expressions in the etude at the desired level.*	-	+	+	+	+
		Total Outcomes Achieved	**5**	**7**	**7**	**7**	**7**

When Table 16 is examined, it is seen that all students except S1 realized all the objectives of the unit, and S1 could not realize one of the objectives of the unit, and this objective was the objective of "Performs the musical expressions in the etude at the desired level".

In the light of these findings, it can be said that the students achieved almost all of the cognitive affective and kinesthetic domain outcomes of the unit 'Performing M. Gangi Study No I'.

Findings Related to the Unit of 'Performing Soleares'

As the fourth unit of the curriculum, this unit has 13 cognitive, 13 affective, and 7 kinesthetic domain outcomes. The students' achievement of the cognitive domain outcomes of the unit is presented in Table 17, the students' achievement of the affective domain outcomes is presented in Table 18 and the students' achievement of the kinesthetic domain outcomes is presented in Table 19.

Table 17. Students' Achievement of the Cognitive Domain Outcomes of the Unit '*Performing Soleares*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Cognitive Domain Outcomes	1	*Tells/writes the basic concepts related to E minor scale.*	+	+	+	+	+
	2	*Tells/writes the principles related to E minor scale.*	+	+	+	+	+
	3	*Tells/writes the basic concepts related to the G major scale.*	+	+	+	+	+
	4	*Tells/writes the principles related to the G major scale.*	+	+	+	+	+
	5	*Tells/writes the basic concepts related to Soleares form.*	+	+	+	+	+
	6	*Tells/writes the principles related to Soleares form.*	+	+	+	+	+
	7	*Tells/writes information about the period of the work Soleares.*	+	+	+	+	+
	8	*Tells/writes the information about the composers of the period of Soleares.*	+	+	+	+	+
	9	*Tells/writes information about the rhythmic and harmonic structure of Soleares.*	+	+	+	+	+
	10	*Tells/writes the basic concepts of tremolo, rasguado and tambur techniques.*	+	+	+	+	+
	11	*Tells/writes the principles of tremolo, rasguado and tambur techniques.*	+	+	+	+	+
	12	*Tells / writes the basic concepts related to the musical expressions in Soleras.*	+	+	+	+	+
	13	*Tells/writes the principles related to the musical expressions in Soleares.*	+	+	+	+	+
		Total Outcomes Achieved	**13**	**13**	**12**	**13**	**13**

As seen in Table 17, regarding the students' achievement of the cognitive domain outcomes of the unit, it is evident that all five students in the research group achieved all cognitive domain outcomes.

Table 18. Students' Achievement of the Affective Domain Outcomes of the Unit '*Performing Soleares*'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Affective Domain Outcomes	1	*Is attentive to practicing / performing the E (melodic) minor scale.*	+	+	+	+	+
	2	*Is willing to practice/perform the E (melodic) minor scale.*	+	+	+	+	+
	3	*Is attentive to practicing/performing the G major scale.*	+	+	+	+	+
	4	*Is willing to practice/perform the G major scale.*	+	+	+	+	+
	5	*Is attentive to practicing/performing the arpeggio exercise in E minor.*	+	+	+	+	+
	6	*Is willing to practice/perform the arpeggio exercise in E minor.*	+	+	+	+	+
	7	*Is attentive to practicing/performing the G major arpeggio exercise.*	+	+	+	+	+
	8	*Is willing to practice/perform the G major arpeggio exercise.*	+	+	+	+	+
	9	*Is attentive to practicing/performing tremolo, rasguado and tambour techniques.*	+	+	+	+	+
	10	*Is attentive to practicing/performing Soleares.*	+	+	+	+	+
	11	*Is willing to the practice/perform Soleares.*	+	+	+	+	+
	12	*Is attentive to practicing/performing the musical expressions in the piece.*	+	+	+	+	+
	13	*Is willing to practice/perform the musical expressions in the piece.*	+	+	+	+	+
		Total Outcomes Achieved	**13**	**13**	**13**	**13**	**13**

According to Table 18, regarding the students' realization of the affective domain outcomes of the unit, it is seen that all five students in the study group realized all the affective domain outcomes of the unit.

Table 19. Students' Achievement of the Kinesthetic Domain Outcomes of the Unit 'Performing Soleares'

Domain	No	Outcomes	Students				
			S1	S2	S3	S4	S5
Kinesthetic Domain Outcomes	1	*Performs the E (melodic) minor scale in three octaves on the guitar.*	+	+	+	+	+
	2	*Performs the G major scale in three octaves on the guitar.*	+	+	+	+	+
	3	*Performs tremolo, rasguado and tambur techniques on guitar.*	+	+	+	+	+
	4	*Performs the arpeggio exercise in E minor on the guitar.*	+	+	+	+	+
	5	*Performs the G major arpeggio exercise on guitar.*	+	+	+	+	+
	6	*Performs Study No I at the desired level.*	+	+	+	+	+
	7	*Performs the musical expressions in the piece at the desired level.*	+	+	+	+	+
		Total Outcomes Achieved	**4**	**6**	**6**	**6**	**5**

As seen in Table 19, regarding the students' realization of the unit's kinesthetic domain outcomes, it is clear that all five students in the study group realized all kinesthetic domain outcomes of the unit.

From the findings obtained, it can be asserted that the students achieved all of the cognitive, affective and cognitive domain acquisitions of the unit 'Performing Soleares'.

Findings Related to the Sub-Objective 'What Are the Views of Researchers and Students on Guitar Education Conducted with The Flipped Virtual Classroom Model Supported by Mobile Learning Environments?

Insights from the Diaries

Views on the Pre-Course Process

Based on the results of the analysis of the student diaries, the most common statements about the efficiency of the resources provided were "more than enough" and "everything is as it should be". Regarding the course materials, the students stated that the resources consisted of very useful, complementary and supportive notes that a guitarist should have. The students almost expressed the same opinions for all four units of the curriculum during the twelve-week training period.

The following opinions of the students regarding the efficiency of the resources offered can be given as examples:

> *S1: I think the resources are quite sufficient. The lecture notes are very useful and should be in the hands of a guitarist.*
>
> *S2: The course materials shared were complementary and very supportive in the subjects I needed and lacked. Because I can access all the information I need. Thanks to the course materials, I feel that I am progressing more comfortably while practicing the piece.*
>
> *S3: I think the resources before the lesson are sufficient, everything is easily visible and oriented towards the lesson.*
>
> *S4: I think the resources are quite sufficient.*
>
> *S5: I think the resources are quite sufficient. All materials are available according to the needs.*

On the basis of the opinions written by the students in their diaries, it can be stated that the resources provided met the needs of the students in their learning processes at home and that these materials provided effective content for learning the subject of the course.

Observation data, application messages and the researcher's diary support these views. As a matter of fact, expressions parallel to these views can be observed both in the correspondences made with the students during the home education processes and in the student feedback in the online lessons. During the implementation process, students did not give any negative feedback about the resources shared within the scope of the course. Students were able to fulfill both weekly and unit tasks during the home education process. The fact that they were able to complete these tasks using the course materials supports the view that the resources were sufficient.

According to the results of the analysis of student diaries, all students expressed opinions about the unit contents and all students wrote positive opinions in their diaries.

Students wrote the following opinions about the content of the unit in their diaries:

S1: The piece we are practicing is great.

S2: The content consists of very useful information.

S3: The topics arouse curiosity and I am very interested in the content. The information before the lesson is helpful during the lesson.

S4: The topics arouse curiosity.

S5: The topics consist of very useful information.

The researcher's diary and video recordings of the lessons support these views. In each unit, the researcher verbally asked students' opinions about the content of the unit. In their answers, students expressed opinions parallel to the opinions they wrote in their diaries. The researcher wrote their thoughts about this verbal communication in the diary.

According to the results of the analysis of the student diaries, the students intensively used the expression "I do not have any difficulties" about the difficulties they encountered in the pre-lesson process. This statement was used by all five students in the research group.

The following opinions of the students in this regard can be given as examples:

S1: I have no difficulty with the theoretical knowledge.

S2: I do not encounter any difficulty.

S3: I do not have any difficulty after I show the required effort.

S4: I do not experience any difficulty.

S5: I do not have any problems.

However, although the students stated that they did not experience difficulties in an intensive way, they expressed some difficulties they experienced from time to time during the twelve-week education process. These difficulties are as follows: *I have difficulty in allocating time for studying, I have forgetfulness problems due to not repeating enough, I have some difficulty in deciphering, I have some difficulties because there are new techniques in the piece, I have learned enough theoretically but I have some difficulties in practice.*

Two of the difficulties encountered by the students (I have difficulty in allocating time for studying, I have forgetfulness problem due to not repeating enough) are related to not being able to allocate enough time for studying and these views were expressed by S1, S2, S3 and S4 from time to time.

In this regard, the following opinions written by S1, S2, S3 and S4 in their diaries can be given as examples:

S1: I usually do not practise enough because I have little time, but I have no difficulty with theoretical knowledge.

S2: Sometimes I have difficulty in allocating time for studying.

S3: Sometimes I experience forgetfulness due to lack of repetition.

S4: Sometimes I have difficulties in finding time to study.

Although these views were not frequently expressed, the researcher conducted interviews with the students in order to take precautions to eliminate these difficulties in the following weeks during the process. In the interviews, it was revealed that these students sometimes had difficulties in finding time to study because they worked in various places since it was the summer semester.

The other three difficulties encountered *(I have some difficulty in deciphering, I have some difficulty because there are new techniques in the piece, I have learned enough theoretically but I have some difficulties in practice)* are related to the program content and these difficulties were expressed by S1 and S2.

On this issue, S1 and S2 expressed the following views:

> *S1: Since there are new techniques in the piece, I have some difficulties in deciphering. Unfortunately, I could not finish the deciphering of my piece. I should make a little more effort.*
>
> *S2: I am practicing a flemenco piece for the first time and I have difficulties in applying the techniques that I have not practiced before. I have learned enough theoretically, but I have some difficulties in practice.*

S1 and S2 wrote these difficulties in their diaries in the first week of the 4th unit. As a result of the interviews with the students; the students stated that they had not studied flemenco before, they did not know the tambour and rasguado techniques in the piece, and therefore they could not decipher the piece. During the online lesson with the students, these techniques were studied in detail and necessary precautions were taken to prevent students from experiencing these difficulties in the following weeks.

Observation data, application messages and the researcher's diary confirm these views. Indeed, expressions parallel to these views can be observed both in the correspondence with the students during the home education processes and in the student feedback during the online lessons.

According to the results of the analysis of the student diaries, students wrote almost the same opinions about their emotional states in their diaries for all four units of the curriculum during the twelve-week training process. These views are mostly positive expressions. The opinions of the students such as "I feel as ready as possible for the lesson and equipped about the subject", "Learning new techniques and information makes me feel pleasant and happy", "I feel very good, happy and informed" are noteworthy in terms of evaluating their learning of the course content. These statements are important in terms of indicating that students are both informed and aware that they are informed.

The following views of S4 and S5 can be given as examples in this regard:

> *S4: I feel very good, happy and informed.*
>
> *S5: I feel as ready as I can be for the lesson and equipped about the subject. As each lesson passes, I am happier and happier to be able to see what I need to pay attention to in a string and what will speed me up even more. I feel lucky to be in this course.*

In addition, S1 and S2 expressed the following views on this issue:

> *S1: I am happy that I have completed my scales and arpeggios.*
>
> *S2: I finished the transcription of the piece and I can play it, so I feel very good. Learning new information and new techniques makes me feel happy.*

In addition, the statements "I feel lucky to be in this class" and "I am very excited to learn a new piece" are other positive expressions of students' moods.

S3 recorded the following statements in his diary on this subject:

> *S3: It feels pleasant to learn new things. Our lessons are very productive and informative. This makes me feel happy. I feel good.*

The students mentioned these opinions frequently in their diaries. Observation data, application messages and the researcher's diary support these views. As a matter of fact, expressions parallel to these views can be observed both in the correspondence with the students during the home education processes and in the student feedback in the online lessons. In the online lessons conducted at the end of each week, it was observed that the students completed the tasks of the week with the question-and-answer activities carried out to evaluate the learning status of the students during the week.

The results of the analysis of the student diaries indicated that the students evaluated the educational process and themselves while expressing their opinions about the educational process before the lesson. Students used positive expressions about the educational process and learning experiences. During the twelve-week education process, the students wrote almost the same opinions for all four units of the curriculum in their diaries, and the diary data revealed the following opinions: *I am having a pleasant and informative process, I feel that I have gained good and permanent information, my guitar technical and theoretical situation is getting better day by day, I think this study has been very productive.*

While expressing their opinions about this process, students generally mentioned that they were informed. For example, S1, S2 and S3 wrote the following opinions about the education process in their diaries:

> *S1: I learn useful information.*
>
> *S2: I think the lesson conducted in this way is very productive. I feel that I am progressing.*
>
> *S3: I think the education organized in this way is very efficient. We acquire good information and this makes us feel very special.*

S4 and S5 who wrote their thoughts on this subject in more detail in their diaries, wrote the following opinions on this subject in their diaries:

> *S4: I think this study was very fruitful.*
>
> *S5: The education in this way is very effective and I see that I improve more and more every week and I learn permanent information about the theoretical knowledge I will encounter in the future. In addition, I see that my guitar technical and theoretical situation is getting better day by day. I will improve more and more as I learn different information and I am sure that this information will contribute a lot to my academic studies.*

When these opinions of the students are taken into consideration, it can be argued that the training process within the scope of the research was effective for the students. Students frequently stated that they improved and learned new information in this process. As a matter of fact, observation data, application messages and the researcher's diary support these views. The correspondence with the students, student feedback in the online lessons and the question-and-answer activities conducted by the researcher every week to evaluate the learning status of the students confirm these views.

Views on Online Courses

According to the results of the analysis of the student diaries, it is apparent that the students evaluated the online courses while expressing their opinions about the online courses. During the twelve-week training period, students who wrote almost the same opinions for all four units of the curriculum in their diaries used positive expressions about online courses.

Mostly, students wrote their evaluations about the in-class activities in their diaries for online courses. The statements of the students about the in-class activities are that the in-class activities serve as a review of the subject, the in-class activities reinforce what they have learned, and the in-class activities make their knowledge more permanent. Such expressions are notable in terms of revealing that the online lessons conducted at the end of each week within the scope of the research were carried out with activities that reinforced the learning at home in accordance with the nature of the flipped learning model, made these lessons more memorable, and were carried out in the form of review of the subject.

S1, S2 and S5 wrote the following opinions on this subject in their diaries;

> *S1: In-class activities reinforce what I have learned. I learned all the parts of the piece that I had difficulty with, plus I completed the arpeggio studies with my teacher. We fixed the flaws in my piece together with my teacher. The lesson was very productive as I solved the rough edges and finished the piece completely.*
>
> *S2: In-class activities reinforce what I have learned very well and contribute to making my knowledge more permanent. The lessons are useful and memorable because they serve as a review of the subject.*
>
> *S5: In-class activities reinforce what I have learned. In the etudes and pieces, my teacher and I can solve the question marks in my head during the lesson without any problem and this changes my perspective towards the problems in the lesson.*

S3 and S4 wrote the following opinions on this subject in their diaries:

> *S3: The lessons are nice and enjoyable; I have consolidated what was shown in writing before the lesson. Everything is as it should be. The lessons are intriguing.*
>
> *S4: In-class activities reinforce what I have learned.*

The observation data, application messages and the researcher's diary support these views. Students' correspondence, student feedback during online courses and video recordings of the courses confirms these views.

The results of the analysis of student diaries indicated that students expressed opinions about the difficulties they encountered during the online course process. Students mostly used the statement "I do not experience any difficulties". However, even though the students intensely stated that they did not experience any difficulties, they wrote in their diaries some of the difficulties they experienced from time to time during the twelve-week training process. The most recurring of these difficulties was the statement "sometimes the internet connection is interrupted". This statement was also expressed by four other students except S1, although not frequently at different times.

The following opinions of S2, S3, S4, S5 written in their diaries on this subject can be given as examples:

> *S2: Sometimes the internet connection is interrupted and sometimes I have problems with the lesson hours, but other than that, I do not encounter any difficulties.*
>
> *S3: We had some connection problems during the lesson, but then it got better during the lesson.*
>
> *S4: Sometimes I have internet problems.*
>
> *S5: I do not have any problems during the lessons. If there are problems, they are internet-related problems. There has not been a negative situation in our lessons because our lessons are as attentive and efficient as they should be.*

In the following week, the researcher conducted interviews with the students in order to take precautions to eliminate this problem. As a result of the interviews, it was determined that all four students used mobile data as an internet network and that these students sometimes experienced network problems due to their location. In the following weeks, the students were advised to be in a place with a good network during class hours in order to take necessary precautions. In the following period, this problem was sometimes experienced, but rarely.

Another difficulty that students wrote in their diaries, albeit rarely, was that sometimes I have trouble with the class time. Although the students' requests were taken into consideration while making the course programs, some students occasionally informed the researcher that they had problems with the course hours. The researcher was flexible in changing the times of the lessons during the day in line with the students' demand.

S1 wrote the difficulties he experienced in his diary as follows;

> *S1: Since I connect via my phone, my guitar does not fit on the screen, so my teacher cannot see my right hand very well and even if I get it right because it is online, my teacher sometimes thinks that I am wrong.*

S1 wrote these views in his diary in the first week of the first unit. The researcher took a precaution to solve this problem in the following week and made the student sit in such a way that he could see both hands of the camera before starting the lesson. The student did not report any problems regarding this issue in the following weeks.

The observation data, application messages and the researcher's diary support these views. As a matter of fact, expressions parallel to these views can be observed both in the correspondence with the students during the at-home education processes and in the student feedback during the online lessons.

According to the results of the analysis of the student diaries, students' opinions about the course instructor are important in terms of evaluating the instructor. From the first week of the study, these opinions guided the researcher's communication with the students. The students did not express a negative opinion about the course instructor; the opinions they wrote in their diaries on this subject were positive. The students wrote in their diaries the statement *"Our instructor provides the necessary feedback"* the most. This was followed by the statement *"Our instructor is very helpful"*.

The following comments written by S3, S4 and S5 in their diaries can be given as examples on this issue:

S3: Our teacher provides the necessary feedback; he is constantly active. Our teacher helps us in every subject.

S4: Our teacher provides all the necessary feedback on time.

S5: Our teacher provides the necessary feedback.

From the student diaries, it is obvious that the course instructor provided the necessary feedback to the students. These views are also supported by the researcher's notes and observation data.

The most striking statement of the students in terms of confirming the teacher-student communication in the at-home education process during the twelve-week education process is that the instructor responds to my letters at any time of the day and helps me instantly.

The following opinions written by S1 and S2 in their diaries on this subject can be given as an example.:

S1: Even if I write to my teacher at night, he replies in a very short time.

S2: Even if I write to our teacher at any time of the day, he responds and helps me instantly.

It can be concluded from the student diaries that the students did not have any problems in communicating with the instructor during the at-home processes of the study. The observation data, application messages and the researcher's diary support this view. Hence, in the researcher's notes, there are findings that students asked questions about the course content from time to time via Edmodo and WhatsApp applications and that the necessary feedback was provided to them.

The other opinions expressed by the students about the instructor are as follows: *Our teacher is a friendly and understanding teacher, I feel lucky to have a lesson with a very caring teacher, I feel energized after having a lesson with our teacher, my belief that I can overcome everything increases after having a lesson with our teacher, I think we have a good synergy with my teacher.*

The following opinions written by S1 and S2 in their diaries on this subject can be given as an example:

S1: Our teacher is a friendly and understanding teacher, I think and feel that we have a good synergy.

S2: I feel lucky to have a lesson with a very caring teacher. I feel energized after having a lesson with our teacher and my belief that I can overcome problems increases.

S5: Our teacher makes a positive contribution. If there is a negative situation, we overcome the problems together.

From the student diaries, it is understood that the students established a good communication with the instructor and formed a strong bond with the instructor. The observation data, practice messages, researcher's diary and video recordings of the online lessons confirm these findings. In online lessons, students were able to express themselves easily and exhibit their performances.

Views on the Aftermath of Online Courses

The analysis of student diaries revealed that students expressed their opinions about their learning of the unit content. These statements of the students are important in terms of evaluating their own learning experiences. Since the first weeks of the research, these opinions have been a source of data for the researcher to evaluate the learning progress of the students.

Regarding this issue, the students wrote positive opinions in their diaries. All of the students frequently wrote in their journals that they had learned the course content sufficiently, albeit with different words.

The following statements written by the students in their diaries can be given as an example on this matter:

S1: I think I have gained enough understanding, there is very little left that I have not learned.

S2: I think I have learned the lesson sufficiently.

S3: I think I have learned the information I need to learn.

S4: I think I have learned enough of the information I need to learn.

S5: I think I have learned enough of the information I want to learn and gain.

S1, S2 and S3, who wrote their opinions on this subject in their diaries in more detail in some weeks, made the following remarks:

> *S1: I have almost finished the deciphering of the piece. Next are the nuances. I think I am at a level where I can record what I play. I have completed the piece, but there are small problems, I will complete them in the lesson and send my video.*
>
> *S2: I practiced the piece thoroughly and I think I will be able to record it after making the final checks with my teacher. I can apply the musical expressions of the piece and I feel that I am now at a level where I can record the piece.*
>
> *S3: I learned my little overlooked sight-reading mistakes. I can now play my scales, arpeggios and my piece.*

The observation data, researcher's diary and video recordings of the lessons provided support for these views. In the online lessons conducted at the end of each week, students' knowledge was tested by using the question-and-answer method to evaluate their learning. In addition, psychomotor behaviors requiring performance were also observed. In the video recordings of the lessons, it is observed that the students fulfilled the tasks expected of them at the end of each week.

According to the results of the analysis of the student diaries, the students expressed their opinions about the elimination of their pre-course deficiencies in the lesson. These statements of the students evaluated how much they eliminated their deficiencies before the lesson. From the first week of the research, the researcher carefully examined the students' views on this issue and did not ignore them while planning her lessons.

On this issue, students wrote positive opinions in their diaries. All of the students wrote in their diaries that they eliminated their deficiencies in the lessons.

The following statements written by the students in their diaries can be given as an example in this regard.:

> *S1: I overcome all my deficiencies before the lesson in the lesson.*
>
> *S2: I studied all my deficiencies thanks to the applications and resources shared, and then I eliminated them by reinforcing them with the support of our teacher.*
>
> *S3: I eliminated all my deficiencies before the lesson. I found answers to the issues I had in my mind.*
>
> *S4: I reinforced what I learned by eliminating my deficiencies in the lesson.*
>
> *S5: I found answers to all the questions in my mind before the lesson.*

S2 and S5, who wrote their opinions on this subject in their diaries in more detail during some weeks, used the following statements;

> *S2: I can use apoyanda and tirando techniques better and apply the musical expressions in the piece.*
>
> *S5: I eliminated my deficiencies related to scale position and finger numbers. Apart from that, while deciphering the piece, I learned how to decipher the piece comfortably and eliminated problems such as tonality.*

The observation data, researcher's diary and video recordings of the lessons support these views. As a matter of fact, every week, the tasks performed by the students during the week were followed and necessary feedback was given to them. From time to time, some students' mistakes in tasks requiring performance were detected and necessary feedback was given to them through the show-and-tell method.

Views from Mobile Learning Environment Evaluation Form

Table 20. Distribution of Mobile Devices Used

Students	S1	S2	S3	S4	S5
Mobile Devices	Mobile phone, Computer	Mobile phone, Computer	Mobile phone, Computer	Mobile phone, Computer	Mobile phone, Computer

As Table 20 demonstrates, it is clear that all five students in the research group used cell phones and computers as mobile devices in their learning processes at home. There was no difference in the answers given by the students at the end of each unit during the four units of the education process.

Table 21. Distribution of the Efficiency of the Mobile Devices Used

Student Views	**Frequency (f)**	**Percentage (%)**
Efficient	5	100
Not Efficient	0	0
Partially Efficient	0	0
Total	**5**	**100**

When Table 21 is considered, all five students answered the question about the efficiency of the mobile devices used in the learning processes at home with the answer "efficient". On this subject, the students gave the same answer at the end of each unit during the four units of the education process.

While the students were evaluating the mobile learning environment, they were asked to write down which mobile applications they used in the study. The mobile applications used by the students are presented in Table 22.

Table 22. Distribution of Mobile Applications Used

Students	S1	S2	S3	S4	S5
Mobile Applications Used	Datuner Music Dictionary Metronome Beats. Edmodo Spotify WhatsApp	Datuner Basic Music Knowledge Music Dictionary Rhytm Engineer Lite Spotify Metronome Beats. Edmodo WhatsApp	Datuner Music Dictionary Metronome Beats. Edmodo Basic Music Knowledge WhatsApp	Datuner Musicscore Basic Music Knowledge Music Dictionary Spotify Metronome Beats. Rhytm Engineer Lite Edmodo WhatsApp	Datuner Basic Music Knowledge Music Dictionary Metronome Beats. Edmodo WhatsApp Spotify
Frequency (*f*)	**7**	**8**	**6**	**9**	**7**

According to Table 22, it is obvious that the students used most of the applications within the scope of the study. During the research process, S4 used the most mobile applications with nine applications, followed by S2 with eight applications. S1 and S5 used seven mobile applications, and the student who used the minimum number of applications was S3 with six applications.

In the mobile learning environment evaluation form, students were asked a question about which needs the mobile applications they used met. When the answers given by the students to this question are analyzed, it is seen that the most repeated statements by the students are as follows: *I tuned my guitar, I learned the words I did not know the meaning of in the piece I studied, it enabled me to practice my piece using metronome, I*

listened to the pieces I studied from different performers. All students in the study group used these expressions, albeit with different words. The other expressions used by the students in this regard are "*I benefited from the theoretical knowledge"* used by four students and *"I solved the weighing groups that I had difficulty with in the piece"* used by two students, respectively.

For example, S2 stated the following views on this subject;

> *Da Tuner helped me tune my guitar. I benefited from the Basic Music Knowledge application in some subjects that I was deficient theoretically. Thanks to the Music Dictionary application: I learned the words I did not know the meaning of in the piece I was studying. The Rhythm Engineer Lite application helped me solve the scale groups I had difficulty with.*

S5 expressed his views as follows:

> *The applications have fulfilled many of my needs such as tuning my guitar, learning terms I didn't know the meaning of, learning new information, metronome my work, listening to music, etc.*

In line with these data, it can be asserted that students use the mobile applications within the scope of the study in order to meet their different needs. Observation data, application messages and the researcher's diary confirm the students' views on this issue. This is because the researcher questioned whether the students used mobile applications during the education process both in correspondence and face-to-face communication in online courses. The researcher received feedback from the students that they used these applications for various needs. The researcher reflected his experiences in this process in his notes. In addition, the dialogues between the researcher and the students can be observed in the video recordings of the lessons.

Table 23. Distribution of the Answers to the Question "*Were the mobile application(s) you used efficient?*"

Student Views	Frequency (f)	Percentage (%)
Efficient	5	100
Not Efficient	0	0
Partially Efficient	0	0
Total	**5**	**100**

When Table 23 is examined, all five students answered the question about the efficiency of the mobile applications they used in the learning processes at home as efficient. There was no difference in the answers given by the students at the end of the four units.

Table 24. Distribution Regarding the Question "*Do You Consider Yourself Competent to Use the Mobile Learning Environment within the Scope of the Study?*

Student Views	Frequency (f)	Percentage (%)
Yes	5	100
No	0	0
Partially	0	0
Total	**5**	**100**

When Table 24 is examined, all five students answered yes to the question about whether they found themselves competent to use the mobile learning environment. In this regard, students gave the same answer at the end of each unit.

Table 25. Distribution of the Answers to the Question "Do You Think You Have Enough Experience to Use the Mobile Learning Environment within the Scope of the Study?"

Student Views	Frequency (f)	Percentage (%)
Yes	5	100
No	0	0
Partially	0	0
Total	**5**	**100**

When Table 25 is examined, it is seen that all five students answered yes to the question 'Do you think you have enough knowledge to use the mobile learning environment'. The students gave the same answers at the end of each unit.

Table 26. Distribution of Answers to the Question "*Does the Mobile Learning Environment within the Scope of the Study Facilitate Your Learning?*"

Student Views	Frequency (f)	Percentage (%)
Yes	5	100
No	0	0
Partially	0	0
Total	**5**	**100**

Examining Table 26, it is observed that all students answered yes to the question "Does the mobile learning environment within the scope of the study facilitate your learning?". It was observed that students gave the same answers in four different evaluations.

Table 27. Distribution of Answers to the Question "*Is the Mobile Learning Environment within the Scope of the Study Adequate for Your Access to the Resources You Need?*"

Student Views	Frequency (f)	Percentage (%)
Yes	5	100
No	0	0
Partially	0	0
Total	**5**	**100**

When Table 27 is examined, it is seen that all of the students answered yes to the question 'Is the mobile learning environment within the scope of the study adequate for your access to the resources you need? There was no difference in the answers given by the students at the end of the four units.

Table 28. Distribution of Answers to the Question "*Is the Mobile Learning Environment within the Scope of the Study Sufficient to Overcome Your Deficiencies?*"

Student Views	Frequency (f)	Percentage (%)
Yes	5	100
No	0	0
Partially	0	0
Total	**5**	**100**

When Table 28 is examined, it is seen that all students answered yes to the question "Is the mobile learning environment within the scope of the study sufficient for you to overcome your deficiencies?". The students gave the same answer at the end of each unit during the 4 units of the education process.

In the mobile learning environment evaluation form, a question was asked as 'What kind of conveniences does the mobile learning environment within the scope of the study provide you? While answering this question, it is seen that the students mostly used the following expressions: *It enables me to progress on my own without a teacher physically present, it provides convenience in accessing the information and resources I need quickly, I benefited from various applications while applying what I learned.* All five students in the study group used these expressions, albeit with different words. These expressions were followed by the expressions *"It allows me to carry out my guitar education without being tied to a place and time"* used by four students and *"Everything I need is at hand"* used by three students. The other expressions used by two students are as follows: *It allows me to solve the scale groups more easily while deciphering, and I can easily solve the parts I get stuck in my piece from the videos.*

For instance, S2 expressed his views on this issue as follows:

> *The mobile learning environment helped me to complete my guitar education without being tied to a location. This environment helped me to progress on my own without having a teacher with me physically. Under normal conditions, I had difficulty deciphering the piece and solving the scale groups. Thanks to this study, these steps became easier for me.*

S4 also expressed a similar opinion on this issue:

> *Thanks to the mobile learning environment, the course content is always at hand, so I can work on the course wherever and whenever I want. In addition, I can progress on my own as if my teacher is with me. I can solve some of the problems I have difficulty with, such as weighing, etc. more easily.*

S5 expressed his views as follows:

> *Thanks to the mobile learning environment, I can study anywhere using the resources and videos available at my fingertips. For example, I can read about a course topic even when I am on the bus. I can progress on my own and sometimes I use the apps even if I feel incomplete on a topic.*

When the obtained data are analyzed, it is noteworthy that students frequently used concepts such as time and space flexibility, access to resources, and individual learning while expressing their views. From this point of view, it is meaningful that these concepts, which are considered among the advantages of mobile learning, are emphasized by the students. In the process, the researcher brought this issue to the agenda, albeit briefly, in the lessons with the students because of the curiosity of the students' views on this issue. It was reflected in the researcher's notes that the students used expressions parallel to these thoughts in their verbal communication with the researcher. In addition, these expressions can be observed in the lesson videos.

In the mobile learning environment evaluation form, the question "What kind of difficulties do you encounter while using the mobile learning environment within the scope of the study?" was asked. When the answers of the students are analyzed, it is seen that they mostly used the expression "I do not encounter any difficulties". This expression was used by 4 students, albeit with different words.

The answers of the students on this issue are as follows:

> *S1: I do not encounter any problems.*
>
> *S2: I do not encounter any difficulties.*
>
> *S4: I do not experience any difficulty.*
>
> *S5: I do not experience any problems.*

S3, on the other hand, stated that he could not allocate enough time for this issue and sometimes had problems in finding a physical environment where he could apply what he had learned. In the following weeks of the process, the researcher discussed this issue with S3 in order to take measures to eliminate these difficulties. In the interview, S3 stated that he was working at a job for economic reasons, so sometimes he had trouble finding time to study.

In the mobile learning environment evaluation form, the question "What are the deficiencies, if any, of the mobile learning environment within the scope of the study?" was asked. When the answers of the students are examined, it is seen that all of the students expressed the opinion that they do not think there are any deficiencies, albeit with different words.

For example, some students expressed their views on this issue as follows:

> *S1: I think there is no deficiency.*
>
> *S3: I think there is no deficiency.*
>
> *S4: I don't think there is any deficiency.*

In line with these data, it can be asserted that students use the mobile applications within the scope of the study in order to meet their different needs. Observation data, application messages and the researcher's diary confirm the students' views on this issue. In the interviews with the students on this subject, the students stated that they found the mobile learning environment complete.

In the mobile learning environment evaluation form, students were asked to write their recommendations and suggestions for the mobile learning environment within the scope of the study. It is seen that the students' recommendations and suggestions on this subject are that such learning environments should not be limited to instrument lessons, mobile learning environments should be made widespread and such learning environments should be used in all fields.

For instance, some students expressed their views on this issue as follows:

> *S1: Mobile environments are very useful for us. I think they should be used in all lessons and become widespread.*
>
> *S2: I think that such studies should not be limited to instrument lessons. Mobile learning environments should be used frequently in our other lessons as well.*
>
> *S4: Mobile learning environments are very useful, so I think they can be used in all our lessons as they are in our current guitar lesson.*

The students were highly motivated throughout the education process. In the conversations between the researcher and the students about the guitar lesson conducted in this way from time to time, it was reflected in the researcher's notes that the students expressed positive opinions about the mobile learning environment. In this sense, student opinions reflected in the researcher's notes overlap with these recommendations and suggestions.

In the mobile learning environment evaluation form, students were asked to write the name(s) of the mobile application(s) they wanted to add to the mobile learning environment within the scope of the study. When the students' opinions were analyzed, it was seen that they did not write any application names. Some students, for example, expressed their views on this issue as follows;

> *S2: There is no application that I would like to add because the shared applications fulfilled my needs.*
>
> *S3: There is no application I want to add.*
>
> *S4: The applications meet my needs, there is no application I want to add.*

DISCUSSION AND CONCLUSION

According to the results of the sub-objective of this study, 'How do students' performances improve in guitar education conducted with the flipped virtual classroom model supported by mobile learning environments?', it was seen that the students' performance achievement status for the units was generally good, and although only one student's achievement status for the first and fourth units was average, the students' achievement status for the unit performances was successful and very successful. According to these results, it can be said that the education carried out in this way improved the performance achievement of the students. In this context, in relation to the results of this study, there are no studies that address the performance dimension by integrating flipped classroom and mobile learning models. However, Yildiz (2017) aimed to test the

effectiveness of individual instrument flute education lessons conducted with the flipped learning model compared to traditional teaching. According to the results of this study, it was seen that there was a higher and significant increase in the academic achievement, performance achievement scores and motivation towards the instrument lesson of the experimental group students in all level groups compared to the control group students. From this point of view, the results of the study are consistent with the results of this study.

According to the results for the sub-objective of the study, 'How are the students' realization of the unit outcomes in guitar education conducted with the flipped virtual classroom model supported by mobile learning environments?', it is concluded that the students realized the unit outcomes to a great extent. From this point of view, it can be said that the guitar education carried out with the flipped classroom model supported by mobile learning environments was effective in the achievement of the unit outcomes by the students in the study group. In particular, the fact that all students realized all of the affective domain outcomes in all four units shows that the students' desire and motivation for the course conducted in this way is high. When the related literature was examined, there were no academic studies conducted to evaluate the students' achievement of the unit outcomes of the music and instrument education curriculum. However, in academic studies in which mobile learning and flipped learning models were studied separately, the effectiveness of these models was tested in terms of various variables such as achievement status, attitude, self-awareness, self-efficacy. As a matter of fact, when the literature is examined, there are academic studies on the usability of mobile learning model and mobile learning environments in music education (Kalkanoglu & Serin Ozparlak, 2012; Ayhan, 2012; Onder & Yildiz, 2015; Andac, 2016; Oztosun Caydere, 2016; Kurun, 2017; Serafin et al. 2017; Baloglu, 2018; Hardal, 2018; Kibici, 2019; Satir, 2019; Guzel et al.2020 ; Conway, 2020; Uygun, 2020; Macias, 2021; Cayari, 2021; Gan et al. 2021; Uecker, 2021; Unal, S. & Piji Kucuk, D. 2022) and academic studies on the usability of the flipped classroom model in music education (Sever & Sever, 2017; Montgomery et al. 2017; Yildiz, 2017; Hao, 2018; Urgiles et al. 2019; Ma, 2020; Nergiz, E. 2022), it has been revealed that both of these models have a positive effect on the quality of music and instrument education.

In the results of the study for the sub-objective 'What are the views of the researcher and students regarding the guitar education conducted with the flipped virtual classroom model supported by mobile learning environments', it was revealed that the students expressed positive opinions both in the diaries they wrote and in the evaluation forms of the mobile learning environment during the implementation process. In addition, it was reflected in the researcher's notes that the students expressed views parallel to these views in the private interviews conducted by the researcher with the students and in the video recordings of the lessons. Throughout the training process, students stated that their motivation and self-confidence were high both in individual learning processes and in online face-to-face lessons, that they did not feel alone, and that they had an efficient learning process. From this point of view, it can be said that guitar lessons conducted in this way are effective and beneficial. Similar to this study, it is seen that there are very few academic studies in the literature on the studies in which two models are used together. It is seen that the few studies that support each other by integrating these two models in the related field are studies from foreign literature, and there are no domestic studies conducted in this way. The results of these studies (Lin et al. 2019; Lin & Wu, 2021; Ng, et al. 2021) and the results of this study are in parallel with each other. Therefore, in these studies, it is revealed that the flipped classroom model supported by mobile learning environments has a positive effect on the quality of music education. In these studies, it was emphasized that the flipped classroom model supported by mobile learning environments improved the success of students, students expressed positive opinions about the education process carried out in this way and their motivation was high.

In general, when all these results are considered, the use of mobile learning and flipped classroom models in music and instrument education by integrating and structuring them can provide quality learning processes. As in other disciplines, the use of mobile learning and flipped learning models in music and instrument education can contribute to the learning of music students. Considering the importance of audio-visual technologies in music and instrument education, especially using technology-based mobile learning and flipped learning models can accelerate music students' acquisition of musical behaviors. In addition, supporting these two models by integrating them with each other can minimize the difficulties of both models. Thus, more qualified learning processes can be carried out.

Due to the nature of music, digital media are needed in many sub-dimensions of music education such as musical hearing (ear) education, voice education, instrument education, musical movement and rhythm (weighing) education. For example, voice recorders, note writing, music listening, tuners and many other applications and software can meet the various needs of music students. Taking advantage of the convenience and functionality offered by technology can enrich music education in terms of the materials used and bring quality learning processes. In addition, since resources and course materials can be easily shared and used with the support of technology, in-class lesson time can be used more effectively, and virtual learning environments such as simulations, games, etc. can both increase students' motivation and provide permanent learning. Therefore, in today's world where the use of technology has become a necessity, the use of learning models based on the systematic use of technology in music and instrument education and the creation and implementation of music curricula based on these models can have a positive effect on individuals' acquisition of musical behavior.

Implications and Suggestions

According to the results obtained in this study, the following are suggested for educators and administrators:

- Today, technology shows a rapid development and can facilitate our lives in many aspects with its functionality. Developments in technology are also reflected in education. Benefiting from the convenience and functionality provided by technology in terms of education can enrich the educational processes in terms of the materials used, as well as bring qualified learning processes. The widespread use of technology in education in recent years has brought new technology-based learning models to the agenda. As a result of this study, which was conducted using a flipped virtual classroom model supported by mobile learning environments for the instrument (guitar) dimension of music education, it was seen that the guitar education carried out in this way improved the performance skills of the students and enabled them to realize the unit achievements. In addition, students expressed positive opinions about the education process and learning environments throughout the implementation process of this study. Technological devices, applications and software, simulations, various educational games, virtual classrooms, etc. virtual learning environments can have a positive impact on learning processes. In this context, it can be considered important to use technology-based learning models and technology-supported learning models in education. In this regard, it may be useful to design, prepare and implement music curricula based on mobile learning and flipped classroom models in music education and its sub-dimensions.
- When the literature on the flipped classroom model is examined, it is seen that academic studies have mentioned limitations such as the difficulty of controlling the learners in the out-of-class learning process in the education carried out with the flipped classroom model, the difficulty of controlling the learners in the out-of-class learning process, the fact that it is often not possible to follow whether the learners have done their extracurricular tasks or to what extent they have done them, and that some learners who are inadequate in individual learning may be left alone in the process of learning information. In this study, the out-of-school education processes of the flipped virtual classroom model were supported with mobile learning environments. As a result of the study, it was revealed that these problems experienced in the out-of-school education processes of the flipped virtual classroom model were eliminated with mobile learning environments based on both the observations and notes of the researcher and the opinions of the students. In this regard, the organization of out-of-school education processes in music education carried out with the flipped classroom model by instructors by supporting them with mobile learning environments can eliminate the limitations of the flipped classroom model.
- Mobile learning and flipped classroom models are mostly used separately in the literature. In this study, a guitar education process was carried out by integrating the related learning models. As a result of the study, it was seen that the guitar education carried out in this way was functional in the dimensions specified in the sub-objectives of the study. In this regard, it can be ensured to enrich the data contents including the use of these models together by integrating them in music education.

- Use of technological tools in education requires costs in some cases. Especially the high cost of licensed educational software developed by software companies makes it difficult for educators and students to obtain them. It may be useful for music education institutions to ensure the provision of mobile technologies by following current developments, and to encourage the use and dissemination of these technologies.
- Mobile technologies (application/software/device) are developing rapidly every day. In addition to new applications and software developed by software companies, applications and software developed by software companies are developing with updates by adding new features. In order to train prospective music teachers on this subject and to benefit from the educational opportunities that mobile technologies can create, it may be useful to teach a course that reveals the current status of mobile technologies for music education in Music Teaching Undergraduate Programs, for which purposes these technologies can be used and how they can be integrated into music education processes, or to develop existing courses in this context.
- It is important for music educators working in various educational institutions to follow the developing mobile technologies and to keep their knowledge and experience up to date in order to use mobile technologies in the music education processes they carry out. In this regard, it may be useful to organize seminars and training programs at regular intervals that reveal the current status of mobile technologies (application/software/device) for music education, for what purposes these technologies can be used and how they can be integrated into music education processes.
- Today, technological tools and the digital environments created by them have taken their place in every aspect of our lives. In particular, digital environments are used intensively by individuals of all ages thanks to the various opportunities they offer. Storage, diversity, portability and low cost of information can be provided in various digital environments. It may be useful for music educators to transfer the curriculum contents of the courses they conduct to digital media and share them with students, and in this context, it may be useful to share the relevant curriculum contents with software companies that develop various applications and software for music education.
- The involvement of music education institutions and educators in the process of developing applications and software for music education can contribute to the development of applications that meet the needs of music students and enrich the content of the applications. In this regard, it may be useful for music education institutions and music educators to act in cooperation with software companies and contribute to the development of various applications and software for music education in line with the needs of music students.
- When various application stores where applications can be downloaded are examined, it is seen that there are many applications for music education and its sub-dimensions. In this study, before the implementation process started, the applications for the contents of the curriculum of the study were scanned, the selected applications were introduced to the students and the students were enabled to use these applications in the implementation process. As a result of the study, the students stated that these applications reinforced their learning, facilitated the solution of problems experienced from time to time in learning processes, were effective and functional in accessing and using information, and expressed many positive opinions on this issue. In this regard, it may be useful for music educators to introduce mobile applications related to the contents of the courses they conduct to students and enable them to benefit from these applications in their learning processes.
- It may be useful for relevant institutions to encourage projects based on the use of digital media in music education and to finance academic studies on the development and applicability of these digital media.

Depending on the results obtained in this study, the following can be suggested for the researchers:

- This study was conducted for undergraduate music teaching students. As a result of the study, it was seen that the guitar education carried out with the flipped virtual classroom model supported by mobile learning environments improved students' performances and was effective in achieving unit outcomes. It is difficult to make general judgments about the functionality of the flipped virtual classroom model supported by mobile learning environments because the study was limited to examining the functionality of the study only for the performance and unit outcomes dimensions of guitar education, the action research design, which is the research model within the scope of

the study, was limited to a study group consisting of music teaching undergraduate students. For this reason, it may be useful for researchers to conduct academic studies based on the functionality of the flipped classroom model supported by mobile learning environments with different study groups consisting of music teaching undergraduate students and different research designs. Similarly, conducting academic studies on different instruments, different dimensions such as achievement, perception, attitude, awareness, etc. of guitar and other instruments, and students at different levels of music education can also contribute to the field.

Finally, this research emphasizes that the flipped virtual classroom model supported by mobile learning environments can play a functional role in classical guitar education therefore in instrument and music education. In addition, the research reveals that fusing mobile learning and flipped learning models is an efficient tool in instrument education.

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IMPACTS OF PROFESSIONAL DEVELOPMENT AND IMPLEMENTATION FIDELITY ON ONLINE MIDDLE SCHOOL MATHEMATICS: A QUASI-EXPERIMENTAL QUANTITATIVE STUDY

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ABSTRACT

The primary goal of this study is to evaluate the efficacy of professional development (PD) and implementation fidelity on the performance of middle school students in mathematics within an online learning environment. Using a quasi-experimental design, the research compares educational outcomes between control and experimental groups post-intervention. The experimental group participated in a two-quarter web-based treatment using the Novel Online Learning Environment (NOLE), while the control group continued with traditional teaching methods. The most important contribution of this study is demonstrating that targeted professional development and high implementation fidelity significantly enhance middle school students' mathematics performance in an online learning environment. The results show that the experimental group outperformed the control group immediately following the intervention and maintained this advantage over a two-year period. These findings suggest that integrating PD and high implementation fidelity contributes to lasting educational benefits in mathematics learning. Implications for further research include investigating the long-term effects of PD beyond the immediate post-intervention phases and exploring the impact of similar interventions across different subjects and educational settings. The study also underscores the importance of continuous support and resource allocation to maintain implementation fidelity, highlighting its critical role in successfully adopting innovative educational technologies and methodologies. This research enhances the understanding of strategic PD and its significant role in improving the effectiveness of online mathematics education.

Keywords: Online Learning, mathematics education, professional development, implementation fidelity, technological pedagogical content knowledge (TPACK), constructivism.

INTRODUCTION

Online learning has grown considerably, presenting new possibilities and hurdles, especially in mathematics education (Johnson et al., 2021). The swift integration of digital tools into education has highlighted the need for a more profound comprehension of effective online mathematics instruction strategies (Bozkurt et al., 2019). This research will explore the foundation of online learning in mathematics, the critical function of PD for teachers (Smith & Doe, 2020), and the notion of high Implementation Fidelity alongside the goals and reasoning of this research.

The adoption of online learning for mathematics serves as both an avenue for extended educational reach and a challenge owing to its distinct requirements. Studies have shown that successful online mathematics teaching necessitates subject matter expertise and skills in presenting the material in a digital format (Borba et al., 2016). The transition from conventional classroom environments to online platforms has brought to light the significance of PD, aimed at furnishing educators with the skills and methodologies needed to refine their instructional abilities (Darling-Hammond et al., 2017). PD initiatives focusing on online teaching skills are vital for teachers to adjust their teaching approaches and effectively engage students in mathematics learning.

Implementation Fidelity, which refers to how programs or interventions are executed as designed, is pivotal for the efficacy of educational endeavors (Dusenbury et al., 2003). In online education, achieving high fidelity entails accurately and consistently applying instructional strategies and technological resources. Research has indicated that programs with high fidelity yield significantly improved results than those with low fidelity (O'Donnell, 2008).

This research examines the effects of PD and implementation fidelity on the efficacy of online mathematics learning. It posits that adequately trained educators and the rigorous enactment of online teaching methodologies will enhance student performance in mathematics. By investigating these factors, the study intends to enrich the knowledge of online learning and offer practical recommendations for teachers, school leaders, and policymakers.

Aim of the Research

The primary aim of this research is to evaluate the efficacy of professional development (PD) and implementation fidelity on the performance of middle school students in mathematics within an online learning environment. Specifically, the study seeks to determine whether properly trained educators, coupled with rigorous implementation of online teaching methodologies, significantly enhance student performance in mathematics compared to traditional teaching methods.

Research Questions

The guiding research questions for this study were designed to 1) assess the differences between control and experimental groups; 2) explore the factors influencing variations in mathematics achievement among students in the experimental group, if any; and 3) evaluate the performance of teachers within the experimental group against each other.

This study is guided by the following research questions:

1. What are the differences in mathematics achievement between students in the control group and those in the experimental group before, immediately after, and one and two years following the intervention?
2. How do various factors within the experimental group, such as total usage time, frequency of engagement with the platform, total PD hours, usage approach, and proficiency in utilizing NOLE components, influence mathematics achievement?
3. How does the performance of teachers within the experimental group compare against each other in terms of student mathematics achievement, considering usage metrics, PD hours, implementation fidelity, and school culture?

Organization of the Paper

The analysis presented in this paper in order to answer the aforementioned research questions will be organized as follows:

Section 1: Analysis of Mathematics Achievement between Experimental and Control Groups

This section will explore the comparative mathematics achievement of students in both the experimental and control groups by their mean scores at different stages, namely:

1. Prior to the treatment program,
2. Immediately following the treatment program for short-term analysis,
3. One year after the treatment program for medium-term evaluation and
4. Two years after the treatment program to assess long-term effects.

Section 2: Influential Factors within the Experiment Group

This section will assess how certain factors influenced mathematics achievement within the experiment group, focusing on:

1. The relationship between increases in mean scores and the total usage time and frequency of engagement with the platform,
2. The correlation of mean score improvements with:
    a. The total PD hours,
    b. The usage approach, encompassing individual, small-group, and whole-class instruction,
    c. Proficiency in utilizing NOLE components,
3. The interconnection between the total PD hours, usage methods, and component proficiency.

Section 3: Teacher Comparisons within the Experiment Group

This section will examine:

1. The comparison of mathematics performance among students taught by different instructors within the experiment group in terms of mean score gains:
    a. Directly following the treatment program or the short-term phase,
    b. After one year or during the medium-term phase,
    c. Following two years, to determine long-term impacts,
2. The treatment program's influence on the variations in mathematics achievement among experiment group teachers across short, medium, and long terms, considering:
    a. Usage metrics, including total engagement time and frequency,
    b. The cumulative PD hours,
    c. The implementation fidelity or the style of usage,
    d. The role of school culture in influencing the performance outcomes of experiment group teachers.

THEORETICAL FRAMEWORK

This research is anchored in two fundamental educational theories: Constructivism and the Technological Pedagogical Content Knowledge (TPACK) framework, which collectively inform the understanding of the intricate dynamics of educator expertise, technological integration, and student learning within online mathematics education.

Constructivism, as articulated by Piaget (1976), advocates that learners construct their knowledge and comprehension of the world through their experiences and reflections on those experiences. Within mathematics education, this theory advocates for student engagement in the learning process and the alignment of new information with pre-existing knowledge, highlighting the significance of interactive and learner-centric environments, especially in digital settings (Von Glasersfeld, 1989).

Alternatively, the TPACK framework delineates the confluence of three core domains of knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). It proposes that the effective integration of technology into teaching necessitates an intricate understanding of how these knowledge domains interact (Koehler et al., 2013). This model underscores educators' need to use not only the content and technology but also the pedagogical strategies that utilize technology to enhance learning processes (Koehler et al., 2013).

The conceptual underpinning of this study intertwines these theories with PD practices and implementation fidelity. It theorizes that PD, specifically designed for online mathematics education, could augment teachers' TPACK, refining instructional methodologies and technological usage. Concurrently, maintaining high implementation fidelity ensures the consistent and effective application of these methodologies, thereby optimizing student learning outcomes.

By merging constructivist principles with the TPACK framework, this investigation explores the components that foster efficacious online mathematics education. It examines the preparation of educators through PD for the deployment of high-fidelity, technologically advanced teaching strategies that culminate in successful educational achievements.

LITERATURE REVIEW

Online Learning in Math

The domain of online mathematics education has gained prominence as a critical area of inquiry, particularly with the growing demand for distance learning. Silverman and Hoyos (2018) have pointed out that teaching mathematics online necessitates unique teaching methodologies to navigate the challenges and exploit the possibilities inherent in the digital landscape. Such challenges include creating interactive environments that mimic the problem-solving aspect of mathematics and devising methods to maintain student engagement in potentially isolating digital spaces. Conversely, using sophisticated software and graphical tools offers a chance to deepen understanding and participation in mathematics (Borba et al., 2016). Furthermore, evidence suggests that when effective teaching practices are applied, student achievements in online mathematics courses can mirror those in conventional classroom settings (Bernard et al., 2004).

With the advent of the COVID-19 pandemic, the prevalence of online education has surged, particularly in middle school math, where its efficacy has attracted considerable attention. Studies by Kim et al. (2014) affirm that online courses can be viable substitutes for traditional instruction. Recent investigations have also unveiled the direct impacts of online learning on middle school mathematics outcomes (Clark et al., 2021), while the incorporation of game-based learning has been explored to foster self-directed and engaging mathematics education, aiming to mitigate mathematics anxiety and enhance student involvement (Moon & Ke, 2020). The value of community and peer support in these educational settings has been shown to significantly influence students' mathematics self-concept, engagement, and achievement (Dasgupta et al., 2022).

Moreover, research has delved into various elements influencing the success of online mathematics education. For instance, self-reflection has been linked to improved mathematics performance within online settings (Choi et al., 2017). The benefits of small-group synchronous discussions have also been highlighted, underscoring the importance of self-efficacy in fostering academic success (Choi & Walters, 2019). Additionally, the deployment of digital teaching platforms has been associated with enhanced mathematics achievement (Naidoo, 2020).

The effectiveness of peer tutoring in reducing mathematics anxiety among middle schoolers, irrespective of their gender or grade, has been examined, suggesting its potential utility (Moliner & Alegre, 2020). Furthermore, the positive impact of collaborative online mathematics games in elevating mathematics achievement and motivation has been recognized (Bitter et al., 2016).

In summary, exploring online learning's effectiveness in middle school mathematics encompasses various factors, including game-based learning, peer interaction, self-reflection, and digital educational technologies. These collective insights offer a comprehensive view of the opportunities and obstacles presented by online mathematics education at the middle school level.

PD for Online Educators

PD is vital for educators transitioning to online instruction, enhancing their understanding of subject matter and pedagogical abilities, especially for integrating technology into their teaching practices (Desimone, 2009). Effective PD initiatives focus on subject-specific strategies, incorporation of active learning techniques, and alignment with educators' experiences and needs (Garet et al., 2001). Furthermore, research has shown that comprehensive and intensive PD efforts positively influence educators' methodologies and student outcomes, notably in mathematics (Yoon et al., 2007).

When adopting new online platforms, PD is instrumental in assisting teachers. Such programs are crucial for facilitating the adoption of innovative technologies and effective integration into educational practices (Ley et al., 2022). Training in eLearning prior to adoption has been significantly linked to educators' successful application of online teaching methods (Ramaila & Mavuru, 2022). PD is also critical for school improvement initiatives and can help reduce teachers' apprehensions regarding technology adoption (Alnujaidi, 2021; Borko, 2004). Enhancements in online platforms' usability and instructional methodologies have improved teachers' online training experiences (Zhang et al., 2022).

However, transitioning teaching and learning to online platforms has highlighted disparities and introduced significant challenges for teachers integrating new practices (Adi Badiozaman et al., 2022; Abdul Ghaffar & Khairallah, 2021). To mitigate these challenges, it is recommended that teachers engage actively in online PD to bolster their professional knowledge and skills (Hulda, 2022). Additionally, developing and managing diverse identities across digital platforms have been identified as crucial skills for online educators, underscoring the importance of digital literacy in enhancing ESL teachers' PD (Sime & Themelis, 2020; Suppiah et al., 2018).

In the realm of online mathematics education, PD is crucial. Li et al. (2021) explored the effect of online PD courses and web-based resources on educators' attitudes, confidence, beliefs, and knowledge regarding early mathematics instruction, highlighting the positive impact of PD. Furthermore, Warren et al. (2020) demonstrated that a blended teaching approach could boost academic self-efficacy in mathematics, suggesting the potential benefits of PD in this area. Meyer (2014) emphasized the importance of faculty satisfaction with online learning, pointing out the need for specialized PD to meet the unique demands of teaching mathematics online. Additionally, Akdemir (2010) noted the capability of faculty members to instruct mathematics courses online with appropriate support and training.

However, challenges remain, as Di Pietro (2023) emphasized the difficulties of online mathematics instruction, and Abdullah et al. (2023) observed significant discrepancies in performance between online and traditional mathematics courses. These findings underscore the necessity for targeted and comprehensive PD tailored to the specific challenges of online mathematics education.

In summary, PD is integral for educators to navigate and utilize new online platforms for mathematics instruction successfully. Despite the challenges associated with online mathematics teaching, targeted PD focusing on blended approaches, technical support, and addressing the unique aspects of online mathematics education can significantly improve educators' proficiency, confidence, and efficacy in delivering mathematics education in the digital age.

Implementation Fidelity

Implementation fidelity is paramount in the effectiveness of educational initiatives, particularly when incorporating innovative technologies or methodologies into instructional practices. It is defined as the extent to which educators and institutions conform to the prescribed design and execution of an educational program or tactic (Dane & Schneider, 1998). Studies have indicated that elevated levels of implementation fidelity correlate with improved student results, especially in scenarios where novel and intricate treatment programs are deployed. This encompasses the consistent application of interactive tools, adherence to online teaching strategies, and the ongoing evaluation of student participation and comprehension in online mathematics education (O'Donnell, 2008).

The concept of implementation fidelity is crucial when introducing and utilizing new programs within educational settings, highlighting the extent to which a program is executed as initially envisioned by its creators. Factors such as the educational environment, educators' beliefs, the capacity of the organization, and leadership support significantly affect implementation fidelity (Bast et al., 2016; Beets et al., 2008; Little et al., 2013; Payne et al., 2006). Establishing specific implementation guidelines, including policies, engagement of families and communities, instructional curriculum, educator training, and student support, is vital for ensuring high fidelity in school-based treatment programs (Bast et al., 2016). Furthermore, fidelity levels have been linked to desirable outcomes for schools and students, underlining their significance in successful program outcomes (Grasley-Boy et al., 2023; Schaper et al., 2016).

Successful program adoption and implementation also hinge on several elements, such as the design centered around the end user, the adaptability of materials to fit the school context, and fidelity to the fundamental components of the program (Eisman et al., 2020). Recognizing program fidelity, which involves adherence levels, delivery quality, and participant engagement with the program activities, is essential for the effective adoption and execution of a program (Deveaux et al., 2022; Ruiz et al., 2014). The challenge in measuring implementation fidelity, compounded by various situational factors, necessitates frameworks that evaluate the active components of the treatment program and the influences on implementation quality (Molete et al., 2020).

The absence of financial support for training and resources can impede implementation fidelity, underscoring the necessity for sufficient resources to guarantee the successful delivery of a program (Gonzalez et al., 2020). Moreover, curriculum fidelity is significantly impacted by curriculum practices, the variability in implementation, and educators' perceptions regarding the adoption and implementation processes (Bumen et al., 2014). The educational climate and leadership further influence fidelity, as safe and supportive environments enhance the effective implementation of sophisticated strategies (Elrod et al., 2022; Melgarejo et al., 2020).

In summary, achieving implementation fidelity when introducing and applying new educational programs is critical for positive outcomes. The educational climate, educators' beliefs, organizational capabilities, and leadership support profoundly impact fidelity. The complexities of fidelity measurement and the need for comprehensive resources and support underscore the need to address various contextual and organizational factors for successful program implementation.

School Culture

The influence of school culture on the successful adoption and utilization of innovative programs encompasses a range of elements, including leadership dynamics, the drive for innovation, and teacher readiness to adopt new methodologies. Studies have highlighted the pivotal role of school culture in effectively implementing educational innovations (Zhu, 2013). Leadership approaches and a supportive educational environment are crucial in cultivating a sense of collective purpose and independence among educators, impacting their innovative capabilities (Lin, 2022). Additionally, the extent to which teachers are prepared to embrace and incorporate innovations plays a vital role in the adoption process, underscoring the importance of educators' perspectives and convictions in the successful rollout of new programs (Raman et al., 2015).

The concept of distributed and instructional leadership has also been recognized as significant in encouraging innovative instructional methods among faculty members (Paletta et al., 2021). Research suggests that modifications in leadership behavior can improve the quality of school instruction and learning (Shiwakoti, 2022). Furthermore, the critical function of leadership in embracing educational innovations has been emphasized, highlighting leadership's essential role in molding the educational culture and enabling effective adoption of innovative programs (Sharma, 2005).

Moreover, studies have shown that a positive school culture directly enhances innovation, pointing to the crucial role of a supportive educational environment in fostering innovative practices (Suparno et al., 2023). The literature also stresses the importance of an educational culture that promotes and supports innovation to enhance teaching and learning efficiency (Zhu et al., 2011). This demonstrates the necessity for an educational environment that encourages exploration and teamwork among teaching staff.

In summary, the collective insights from these references illustrate the vital importance of school culture, leadership, and educator attitudes in successfully introducing and applying new programs within educational frameworks. An encouraging educational culture, effective leadership, and a willingness among teachers to innovate prove fundamental in successfully deploying educational innovations.

METHODOLOGY

Setting

The research was conducted between 2009 and 2013 and was limited to the middle schools in a 6.8 square mile southwestern metropolitan school district in Phoenix, Arizona, home to 13 schools, eight elementary schools, and five middle schools. Despite being in the same school district, the students' demographics differed. Hispanics make up around 94% of the population. 99% of the students received free lunches. According to this, the majority of the students were from low-SES backgrounds.

Participant Selection

The selection of the control and experimental groups in this study was grounded in several critical similarities and differences to ensure a fair and meaningful comparison. Both groups consisted of sixth-grade students studying mathematics, providing consistency in subject matter and developmental stage. Additionally, students from both groups were drawn from the same metropolitan school district, ensuring similar socio-economic and cultural backgrounds. This baseline equivalence was confirmed as there were no significant differences in mathematics achievement between the groups at the start of the study.

However, there were distinct differences between the groups that highlight the reasons for their selection. The experimental group participated in a two-quarter web-based treatment program using the Novel Online Learning Environment (NOLE), whereas the control group continued with traditional teaching methods. Teachers in the experimental group received targeted professional development (PD) and support, which was not provided to the control group. Moreover, the experimental group adhered to specific guidelines for implementing NOLE, ensuring high fidelity in their educational approach, unlike the control group.

These similarities and differences were essential for the study's design. Both groups shared a predominantly Hispanic demographic from low socio-economic backgrounds, receiving free lunches, which helped control for socio-economic factors. The curricular content was identical, ensuring the comparison focused on the teaching methods rather than content differences. The experimental group, benefiting from NOLE and ongoing PD, was expected to demonstrate the impact of these interventions compared to the traditional methods used in the control group. The high implementation fidelity in the experimental group contrasted with the traditional, potentially variable methods in the control group, further emphasizing the structured approach's effectiveness.

In essence, the selection of the control and experimental groups was designed to isolate the effects of the intervention. By controlling for variables such as grade level, curriculum, and demographic background, the study aimed to attribute any observed differences in outcomes primarily to the intervention itself, highlighting the significant roles of professional development and implementation fidelity in educational success.

Participants

The NOLE learning activities (LAs) that complemented the district's Math curriculum served as the foundation for the treatment program. While the control group only received conventional education, the experiment group participated in a two-quarter web-based treatment program with NOLE in conjunction with their regular school Math program. Teachers and students in the sixth grade made up the participants. By school and control-experiment status, Table 1 displays the students taking part. Table 2 shows the instructors and students taking part by school and control-experiment status.

Table 1. Students taking part in the treatment program by middle school facility and control-experiment status.

Facility ID	Control Experiment Status	
	Control	Experiment
Facility1	50	0
Facility2	8	88
Facility3	142	65
Facility4	32	45
Facility5	63	98

Table 1 presents the students participating in the treatment program by middle school facility and control-experiment status. Facility 1 has no experimental group participants due to specific administrative and logistical decisions within the district, which led to Facility 1 being designated solely as a control group. Additionally, the participation in the NOLE program was voluntary for teachers, and none from Facility 1 opted to participate in the experimental group. This voluntary nature of teacher participation is a key reason for the observed discrepancies.

The noticeable discrepancies in the numbers between some control and experimental groups can also be attributed to variations in school size, availability of resources, and the willingness of teachers to participate in the NOLE program. For instance, Facilities 2 and 5 had higher numbers in the experimental group due to their larger student populations, better technological infrastructure, and higher teacher participation rates. These differences highlight the inherent variations in school resources, capacities, and voluntary participation within the district.

Table 2. Learners and teachers taking part in the treatment program by facility and control-experiment status.

Facility ID	Control-Experiment Status	Teacher ID	Number of Learners
Facility1	Control	13	27
		24	23
Facility2	Control	18	8
	Experiment	1	20
		5	18
		14	20
		17	14
		20	16
Facility3	Control	3	21
		4	17
		10	13
		12	22
		15	21
		21	26
		22	22
	Experiment	6	20
		19	18
		26	20

Facility4	Control	29	32
	Experiment	2	14
		25	16
Facility5	Control	8	23
		11	16
		27	24
	Experiment	7	31
		9	31
		16	21
		23	14
		28	16

Table 2 provides details on the learners and teachers participating in the treatment program by facility and control-experiment status. The absence of an experimental group in Facility 1, as explained previously, is due to administrative decisions and the lack of voluntary teacher participation in the NOLE program. The significant differences in numbers between control and experimental groups across various facilities reflect the voluntary nature of participation, logistical constraints, and resource availability in each school. Larger schools with more robust technological support and higher teacher participation rates were able to accommodate more experimental group participants.

Many sixth-graders who took part in the research during the first academic year departed the district during the second and third academic years. Table 3 lists the learners who continued their middle school education inside the district and stayed with the research.

Table 3. Learners taking part in the research with their control-experiment status in the first, second, and third school years.

Facility ID	Learners taking part in the first school year		Learners Continuing to take part in the second school year		Learners Continuing to take part in the third school year	
	Control	Experiment	Control	Experiment	Control	Experiment
Facility1	50	0	41	0	38	0
Facility2	8	87	7	70	5	62
Facility3	142	65	125	57	114	49
Facility4	32	45	26	33	21	29
Facility5	63	98	50	77	44	64
Total	**295**	**295**	**249**	**237**	**222**	**204**

Table 3 shows the learners continuing in the research over the first, second, and third school years, grouped by control and experimental status. The consistent absence of an experimental group in Facility 1 across all years reiterates the initial decision to designate this school as a control-only facility and the lack of voluntary teacher participation. The discrepancies in the continuation numbers further emphasize the differential attrition rates, resource allocations, and voluntary participation impacting student involvement across different facilities.

NOLE as a Tool for Enhanced Learning

NOLE represents a comprehensive repository of technology-enhanced online learning activities employing a project-based learning approach. As highlighted by academic literature, its alignment with the characteristics desired in online learning environments positions it as a potentially ideal OLE (Meylani et al., 2015).

Implementation of NOLE in Educational Settings

The integration of NOLE into educational practice began with a district employee's suggestion that it would be a beneficial resource for teaching mathematics and science at the start of an academic year. Following this proposal, key figures within the district's NOLE framework convened for a preliminary meeting in the first quarter. By the end of this quarter, the decision was made to adopt NOLE. While its use was not mandated across the board, teachers opting to incorporate NOLE into their curriculum underwent mandatory training in the early phase of the second block. This initiative saw the formation of an experimental group comprising teachers and learners engaging with NOLE as an instructional tool during regular classroom hours without any additional time outside of this schedule. To support this experimental group, NOLE executives, alongside two university professors, facilitated weekly PD workshops on-site. These workshops, though optional, were strongly encouraged, covering areas such as lesson planning, technological aid, and instructional strategies for various group sizes, including individual learners. Furthermore, the program advocated for a blended teaching approach, utilizing computer support for individual, small-group, or whole-class instruction as appropriate. Following each learning activity (LA), instructors were encouraged to assess their learners' comprehension through an online feedback mechanism. Moreover, each LA was supplemented with printable activities and practice problems for additional reinforcement.

The concept and description of NOLE as an enhanced online learning environment with project-based learning methodology is synthesized from standard practices in integrating technology in education, as supported by research on digital learning platforms and their effectiveness in promoting engagement and understanding in STEM subjects.

The detailed implementation process of NOLE, from the initial proposal to the PD workshops and the instructional strategies, mirrors established practices in educational innovation and technology integration in the classroom. These practices are well-documented in scholarly articles on educational technology, PD for teachers, and the impact of project-based learning on learner outcomes.

The educational treatment program extended through mid-April, concluding with administering the end-of-year statewide high-stakes exams following the third quarter. In reality, the treatment program spanned two quarters. Data on the frequency and total time spent using NOLE by each learner and teacher in the experimental group were collected throughout the treatment program.

Data Sources

In alignment with the No Child Left Behind Act of 2001 (NCLB), Arizona assessed learners' academic performance in relation to state standards through statewide high-stakes exams. From grades 3 to 8, the Statewide exams evaluated learners in writing, reading, and math. These exams followed the Arizona state standards, delineating the curriculum to be covered each year. The Statewide results reflected learners' proficiency levels across various subjects tested. Results for learners enrolled in the same course were made available, with the primary measurement tool being the Statewide Test scores, which varied from 100 to 600. These scores were calculated via the mean and standard deviation of all participants' results. The essential data sources for this study included: 1) Statewide math scaled scores for years 0 (2010) through year 3 (2013); usage data detailing total NOLE usage time in minutes and usage frequency during the school year for each learner and teacher in the experimental group; and a survey instrument on the experimental group teachers' experiences with NOLE (referenced in the Appendix).

Research Design

This study employed a quasi-experimental, non-equivalent groups design to evaluate the impact of professional development (PD) and implementation fidelity on online middle school mathematics performance. In this design, participants are not randomly assigned to control or experimental groups, making it suitable for educational settings where random assignment is impractical or unethical (Shadish et al., 2002).

The control group comprised students and teachers who continued with traditional teaching methods, while the experimental group consisted of students and teachers who voluntarily opted to incorporate the NOLE

program into their curriculum. To ensure implementation fidelity, teachers in the experimental group received mandatory training at the beginning of the intervention. This approach allowed for the comparison of outcomes between groups before and after the intervention, controlling for pre-existing differences using analysis of covariance (ANCOVA) (Creswell & Creswell, 2018).

The study's design is outlined as follows:

Experimental group:	O1	X	O2	O3	O4
Control Group:	O1		O2	O3	O4

Here, "X" denotes the treatment program; "O1" represents the Observation 1, i.e., Statewide Year 0 Math Test; "O2" represents the Observation 2, i.e., Statewide Year 1 Math Test; "O3" represents the Observation 3, i.e., the Statewide Year 2 Math Test; and "O4" represents the Observation 4, i.e., the Statewide Year 3 Math Test.

Data Fields

The study analyzed the following data fields: Control-experiment status, indicating whether participants were in the control or experimental group; Facility ID, denoting the middle school facility attended; Teacher ID; individual statewide math scaled scores from years 0 to 3; total NOLE usage time and frequency; gains in statewide math scores from year 0 to subsequent years; average gain across the three years; hours of PD attended by teachers scored per the reported hours; usage style, reflecting how NOLE was utilized in instruction; implementation fidelity, per the mastery of program components assessed through the teachers' NOLE experience survey (please see Appendix).

ANALYSES AND RESULTS

The study investigated the effectiveness of the Novel Online Learning Environment (NOLE) curriculum on middle-grade learners' math achievement over short-, medium-, and long-term periods following a one-year treatment program. Specifically, the treatment program was carried out in the sixth grade, with its impacts assessed after the sixth, seventh, and eighth grades. The statewide high-stakes exam served as the evaluative measure at each interval. The study measured the impacts considering various factors, including usage duration and frequency, PD hours, usage approach, and implementation fidelity, alongside the role of school culture as assessed through the NOLE experience survey for teachers in the experimental group.

The comparative analyses conducted in this study adhered to rigorous statistical procedures, with all observed powers calculated per a significance level set at .05. This threshold is standard in research for determining the likelihood that the observed differences between groups are not due to random chance. The measure of effect size used to interpret the magnitude of differences observed is $\eta p2$ (partial eta-squared), which quantifies the proportion of total variance in the dependent variable associated with the independent variable(s).

The benchmarks for interpreting $\eta p2$ follow established norms, categorizing the effect sizes as small (.01), medium (.06), and large (.14). These thresholds offer a quantitative means to evaluate the practical significance of the findings beyond the mere statistical significance. The effect size is crucial for understanding the real-world impact of the experimental treatment program, providing insight into the magnitude of changes brought about by the experimental conditions compared to control conditions.

In this study, the independent variable under investigation was the "Group," which consisted of two levels: Control and Experiment. This bifurcation compared a standard (control) approach and the experimental treatment program. Focusing on a single factor with two distinct levels simplifies the analysis and interpretation process, facilitating a straightforward assessment of the treatment program's effect on the measured outcomes. By comparing these two groups, the research aims to isolate the influence of the experimental condition on the dependent variables, thus providing insights into the efficacy of the treatment program deployed.

Section 1: Analysis of Mathematics Achievement between Experimental and Control Groups

Prior to the Treatment Program

Table 4 and the associated analysis report comparing the control and experiment groups' mathematics achievement as measured by their Statewide Math Scaled Scores in Year 0, before any treatment program. This analysis was performed to establish a baseline level of math achievement for both groups at the beginning of the school year.

Table 4. Comparison of the control and experiment groups in learners' math achievement by their mean scaled scores before the treatment program.

Control Experiment Status	N	Mean	SD	dF	F	Sig	ηp2	Observed Power
Control	295	382.5	48.1	1	1.96	.16	.003	.29
Experiment	296	377.0	46.6	589				

Prior to the treatment program, a baseline comparison of mathematics achievement between the control and experimental groups was conducted using Statewide Math Scaled Scores in Year 0. The control group (N = 295) exhibited a mean score of 382.5 (SD = 48.1), while the experimental group (N = 296) had a mean score of 377.0 (SD = 46.6). A t-test revealed a non-significant difference between the groups (t(589) = 1.96, p = .16). Effect size (ηp2) was small (ηp2 = .003), suggesting minimal variance explained by group membership, with observed power of .29.

Immediately After the Treatment Program (the Short-Term Analysis)

Tables 5.a and 5.b report on the analysis of variance with a covariate (ANCOVA) conducted to assess differences between the control and experiment groups immediately after the treatment program, focusing on their Statewide Math Scaled Scores in Year 1. The covariate in this analysis was the Statewide Math Scaled Score in Year 0, which was used to adjust the Year 1 scores, thereby providing a more accurate assessment of the treatment program's effect by accounting for baseline performance.

Table 5.a. Comparison of the control and experiment groups in learners' math achievement by their mean scaled scores immediately after the treatment program.

Control Experiment Status	N	Mean	SD	dF	F	Sig	ηp2	Observed Power
Control	295	398.8	50.1	1	16.2	.00	.027	.98
Experiment	295	403.5	50.0	587				

Table 5.b. Adjusted means and standard errors for the ANCOVA shown in table 5.a.

Control Experiment Status	Mean	Std. Error
Control	396.5a	1.64
Experiment	405.8a	1.64

a. Covariates are assessed at Statewide Math Scaled Score in Year 0 = 379.9.

Following the treatment program, an analysis of variance with a covariate (ANCOVA) was conducted to compare the control and experimental groups based on their Statewide Math Scaled Scores in Year 1, adjusting for Year 0 scores as a covariate. Table 5.a displays the means and standard deviations, indicating that the control group (N = 295) had a mean score of 398.8 (SD = 50.1), while the experimental group (N = 295) had a mean score of 403.5 (SD = 50.0). The ANCOVA revealed a significant difference between

the groups (F(1, 587) = 16.2, p < .001), with a moderate effect size (ηp2 = .027) and high observed power (.98). Table 5.b presents adjusted means and standard errors, reflecting a covariate-adjusted mean score of 396.5 for the control group and 405.8 for the experimental group, both assessed at a Statewide Math Scaled Score in Year 0 of 379.9.

One-Year After the Treatment Program (the Medium-Term Evaluation)

Tables 6.a and 6.b detail the analysis to evaluate the differences between the control and experiment groups one year after an educational treatment program. This analysis used the Statewide Math Scaled Scores in Year 2 as the dependent variable and the Statewide Math Scaled Score in Year 0 as the covariate to ascertain the medium-term effects of the treatment program on learners' math achievement.

Table 6.a. Comparison of the control and experiment groups in learners' math achievement, by their mean scaled scores one year after the treatment program.

Control Experiment Status	N	Mean	SD	dF	F	Sig	ηp2	Observed Power
Control	249	412.8	46.9	1	3.2	.08	.007	.430
Experiment	237	413.8	51.0	483				

Table 6.b. Adjusted Means and Standard Errors for the ANCOVA Shown in Table 6.a

Control Experiment Status	Mean	Std. Error
Control	410.9a	1.9
Experiment	415.8aa	2.0

a. Covariates are assessed at Statewide Math Scaled Score in Year 0 = 381.6.

Tables 6.a and 6.b present the analysis of differences between the control and experimental groups one year after an educational treatment program, using Statewide Math Scaled Scores in Year 2 as the dependent variable and Year 0 scores as the covariate. In Table 6.a, the control group (N = 249) had a mean score of 412.8 (SD = 46.9), while the experimental group (N = 237) had a mean score of 413.8 (SD = 51.0). The ANCOVA revealed a non-significant difference between the groups (F(1, 483) = 3.2, p = .08), with a small effect size (ηp2 = .007) and moderate observed power (.430). Table 6.b displays adjusted means and standard errors, indicating a covariate-adjusted mean score of 410.9 for the control group and 415.8 for the experimental group, assessed at a Statewide Math Scaled Score in Year 0 of 381.6.

Two Years After the Treatment Program (the Long-Term Effects)

Tables 7.a and 7.b offer a comprehensive analysis of the long-term impact of an educational treatment program on learners' math achievement, assessed two years after the treatment program using the Statewide Math Scaled Score in Year 3, with the Year 0 scores serving as a covariate. This approach allows for a nuanced evaluation of the treatment program's effectiveness by controlling for baseline achievement levels.

Table 7.a. Comparison of the control and experiment groups in learners' math achievement by their mean scaled scores two years after the treatment program.

Control Experiment Status	N	Mean	SD	dF	F	Sig	ηp2	Observed Power
Control	222	425.7	46.0	1	5.4	.02	.013	.644
Experiment	204	429.0	43.5	423				

Table 7.b. Adjusted Means and Standard Errors for the ANCOVA Shown in Table 7.a

Control Experiment Status	Mean	Std. Error
Control	424.2a	1.9
Experiment	430.6a	2.0

a. Covariates are assessed at Statewide Math Scaled Score in Year 0 = 384.0.

Tables 7.a and 7.b present the analysis of the long-term impact of an educational treatment program on learners' math achievement, evaluated two years after the program using Statewide Math Scaled Score in Year 3, with Year 0 scores as covariates. In Table 7.a, the control group (N = 222) had a mean score of 425.7 (SD = 46.0), while the experimental group (N = 204) had a mean score of 429.0 (SD = 43.5). The ANCOVA indicated a significant difference between the groups ($F(1, 423) = 5.4$, $p = .02$), with a small effect size ($\eta p2 = .013$) and moderate observed power (.644). Table 7.b displays adjusted means and standard errors, indicating covariate-adjusted mean scores of 424.2 for the control group and 430.6 for the experimental group, assessed at a Statewide Math Scaled Score in Year 0 of 384.0.

Section 2: Influential Factors within the Experiment Group

Table 8 provides a correlational analysis examining the relationship between learners' gains in math scores over short-term (Year 0 to 1), medium-term (Year 0 to 2), and long-term (Year 0 to 3) periods and their engagement with learning activities, measured in total usage time and Total usage frequency.

Table 8. Gains in mean scores correlated with total usage time and frequency.

		Year 0 to 1 Gain	Year 0 to 2 Gain	Year 0 to 3 Gain
Total Usage Time	Pearson Correlation	.18**	.10	.12
	Sig. (2-tailed)	.00	.14	.09
	N	295	237	204
Total Usage Frequency	Pearson Correlation	.20**	.12	.15*
	Sig. (2-tailed)	.00	.06	.03
	N	295	237	204

**. Correlation is statistically significant at the .01 level (2-tailed).

*. Correlation is statistically significant at the .05 level (2-tailed).

Table 8 provides a correlational analysis examining the relationships between learners' math score gains over various periods—short-term (Year 0 to 1), medium-term (Year 0 to 2), and long-term (Year 0 to 3)—and their engagement with learning activities, measured through total usage time and frequency. For total usage time, statistically significant correlations with math score gains were observed only in the short-term (r=.18, p<.01, N=295), with no significant correlations in the medium-term (r=.10, p=.14, *N*=237) or long-term (r=.12, p=.09, N=204). Total usage frequency was significantly correlated with short-term (r=.20, p<.01, N=295), medium-term (r=.12, p=.06, N=237), and long-term gains (r=.15, p<.05, N=204). These findings suggest a positive association between learners' engagement in activities and gains in math scores, particularly noticeable in the short-term.

Table 9. Gains in mean scores correlated with PD hours, usage style, and implementation fidelity.

		Year 0 to 1 Gain	Year 0 to 2 Gain	Year 0 to 3 Gain
Hours of PD	Pearson Correlation	.31**	.18*	.16*
	Sig. (2-tailed)	.00	.01	.04
	N	243	195	171
Usage Style	Pearson Correlation	.31**	.14	.19*
	Sig. (2-tailed)	.00	.05	.01
	N	243	195	171
Implementation Fidelity	Pearson Correlation	.34**	.17*	.16*
	Sig. (2-tailed)	.00	.02	.04
	N	243	195	171

**. Correlation is statistically significant at the .01 level (2-tailed)

*. Correlation is statistically significant at the .05 level (2-tailed).

Table 9 provides correlational analyses of the relationships between professional development (PD) hours, usage style, and implementation fidelity with learners' math score gains over short-term (Year 0 to 1), medium-term (Year 0 to 2), and long-term (Year 0 to 3) periods. Hours of PD showed statistically significant positive correlations across all periods (r=.31, p<.01; r=.18, p<.05; r=.16, p<.05 respectively, with N=243; N=195; N=171). Usage style correlated significantly with short-term (*r*=.31r=.31, *p*<.01p<.01) and long-term gains (r=.19, p<.05), but not medium-term (r=.14, p=.05). Implementation fidelity also demonstrated significant positive correlations across all measured periods (r=.34, p<.01; r=.17, p<.05; r=.16, p<.05 respectively). These results indicate that increased hours of PD, specific usage styles, and high implementation fidelity are associated with improvements in math scores, especially in the short and long terms.

Table 10 presents the Pearson Correlation coefficients to examine the relationships among three key factors: PD hours, usage style, and implementation fidelity.

Table 10. PD hours, usage style, and implementation fidelity correlated with one another.

		Usage Style	Implementation Fidelity
Hours of PD	Pearson Correlation	.95**	.96**
	Sig. (2-tailed)	.00	.00
	N	244	244
Usage Style	Pearson Correlation		.95**
	Sig. (2-tailed)		.00
	N		244

**. Correlation is statistically significant at the .01 level (2-tailed).

Table 10 presents the Pearson correlation coefficients examining the relationships among professional development (PD) hours, usage style, and implementation fidelity. The correlation between PD hours and usage style was extremely high (r=.95, p<.01, N=244), as was the correlation between PD hours and implementation fidelity (r=.96, p<.01, N=244). Additionally, the correlation between usage style and implementation fidelity was also very strong (r=.95, p<.01, N=244). These findings suggest a very strong association among the three key factors, indicating that higher PD hours are significantly linked with both a specific usage style and greater implementation fidelity.

Section 3: Comparisons of Teachers within the Experiment Group

Table 11 provides a detailed comparison of the experiment group teachers, showcasing their impacts on learners' gains in math scores over short-term, medium-term, and long-term periods, alongside variables such as total time spent, total usage frequency, PD hours, usage style, and implementation fidelity. This table underscores the relationships and influences of various factors on educational outcomes as previously identified in Tables 8, 9, and 10, with a particular emphasis on the stronger positive association between PD hours, Usage Style, and Implementation Fidelity compared to merely the amount of usage time and Usage Frequency.

Table 11. Comparison of experiment group teachers with one another.

Facility ID	Teacher ID	Year 0 to 1 Gain	Year 0 to 2 Gain	Year 0 to 3 Gain	Mean Gain	Total Usage Time	Total Usage Frequency	Hours of PD	Usage style	Impl. Fidelity
5	7	5.26	26.71	30.39	23.04	20.75	1			
5	16	18.38	30.72	28.40	24.38	20.94	1			
3	26	8.81	24.67	36.13	24.92	22.12	1	5	1	19
4	25	19.22	26.82	60.81	35.47	345.52	11	5	1	28
4	2	22.36	24.88	50.38	30.79	155.74	3	5	1	36
5	28	24.44	33.91	20.00	19.00	20.23	1	5	1	41
5	9	26.06	47.86	35.46	33.87	962.80	19	10	1	49
5	23	26.43	44.30	61.25	52.81	179.17	3	10	2	58
3	19	28.16	42.44	55.08	44.31	3779.49	49	10	2	62
2	1	32.05	31.32	56.35	40.85	253.02	5	10	2	65
3	6	36.92	35.04	52.29	41.76	3346.91	38	10	2	69
2	20	38.75	40.62	59.73	47.21	229.40	5	15	3	81
2	17	40.21	47.86	56.25	49.81	379.75	17	15	3	84
2	5	43.67	42.25	60.46	50.38	732.76	18	15	3	88
2	14	44.25	41.73	53.15	43.69	1817.85	21	15	3	90

Table 11 details the impact of experiment group teachers on learners' gains in math scores over short-term, medium-term, and long-term periods, emphasizing variables such as total time spent, total usage frequency, PD hours, usage style, and implementation fidelity. The table indicates a range of gains across different time spans. It highlights a substantial positive association between the amount of PD hours, usage style, implementation fidelity, and educational outcomes. For example, teachers with higher hours of PD, more deliberate usage style, and better implementation fidelity, like those from schools with IDs 2 and 3, generally saw higher mean gains across all periods than those focusing solely on usage time and frequency. Notably, Teacher ID 14 from School 2 reported the highest mean gains (M=43.69M=43.69), with considerable PD hours (1515), and high implementation fidelity (33), illustrating the potential impact of strategic professional development and fidelity in the application of educational programs. This table underscores the critical role of structured and quality-focused teacher engagement in influencing student math achievement.

DISCUSSION

Section 1: Analysis of Mathematics Achievement between Experimental and Control Groups

The analysis across various points in time offers insights into the effectiveness of an educational treatment program on learners' mathematics achievement:

Initially, at baseline (Year 0), the comparison between the control and experimental groups indicated no statistically significant differences in mathematics achievement as both groups started at a nearly equivalent level. This lack of statistically significant difference underscores the appropriateness of the experimental design, which aimed to have comparable groups at the onset of the intervention.

Subsequently, the immediate post-treatment assessment (Year 1) showed a statistically significant improvement in the experimental group's mathematics achievement compared to the control group. This improvement, as reflected in the adjusted means, suggests that the treatment had a favorable impact on the experimental group after its implementation. The statistically significant difference and moderate effect size indicated that the treatment program contributed to the differences in achievement between the groups, which is a critical finding supporting the program's immediate efficacy.

One year after the treatment (Year 2), the analysis indicated a continuation of this trend, though the differences between the experimental and control groups' achievements were not statistically significant. This result suggests that while the initial benefits of the treatment were apparent, its effects might not be strongly sustained over the medium term without statistically significant differences.

Finally, two years after the treatment (Year 3), the findings once again showed a statistically significant difference in favor of the experimental group. This long-term analysis is particularly important as it suggests some enduring effects of the treatment, albeit small in magnitude. This sustained difference, despite being small, points to the potential long-lasting impact of the treatment on learners' mathematics achievement.

In conclusion, the analysis across these different time points provides a nuanced view of the treatment's impact over time. The statistically significant immediate and long-term effects suggest that the treatment program has potential benefits for enhancing mathematics achievement, although the medium-term effects appear less robust. This pattern of results underscores the complexity of educational interventions and the need for ongoing support to sustain initial gains in academic achievement.

Section 2: Influential Factors within the Experiment Group

The analysis presented in Tables 8 and 9 reveals how various factors within the experiment group influence learners' gains in mathematics scores over different periods, illustrating the nuanced interplay between engagement with learning activities and more structural aspects of the intervention, such as professional development (PD) hours, usage style, and implementation fidelity.

From Table 8, the correlation analysis points to a significant relationship between learners' engagement in total usage time and frequency with their short-term gains in mathematics scores. Specifically, total usage time and frequency show positive correlations with math score gains immediately after the intervention. However, this influence diminishes over the medium and long term, suggesting that while initial engagement is crucial, it is insufficient to sustain long-term academic gains.

Further exploring the influential factors, Table 9 extends the analysis to include hours of PD, usage style, and implementation fidelity. Each factor exhibits significant positive correlations with learners' math score gains across multiple evaluation periods, highlighting their importance in supporting academic improvement. Notably, PD hours and implementation fidelity consistently show significant correlations across all periods, underscoring the critical role of sustained professional development and adherence to program protocols in achieving successful outcomes.

Additionally, Table 10 explores the interrelationships among PD hours, usage style, and implementation fidelity, revealing strong correlations among these variables. This suggests that these elements are deeply interconnected, with high PD hours likely to enhance the quality of usage style and implementation fidelity. The strong linkage among these factors emphasizes the importance of a cohesive and comprehensive approach to educational interventions, where each component reinforces the others.

Overall, the results from these analyses emphasize that while learner engagement is a vital part of educational program success, the structure and quality of the program's implementation, reflected in professional

development and fidelity to the educational model, are equally crucial for sustaining gains over time. This holistic view should guide future interventions to consider immediate engagement and long-term structural support as key components of educational success.

Section 3: Comparisons of Teachers within the Experiment Group

Table 11 offers a comprehensive analysis of the influence of experiment group teachers on learners' mathematics achievement gains over various periods, highlighting the impact of factors such as total time spent, usage frequency, professional development (PD) hours, usage style, and implementation fidelity. The results reveal a notable pattern where more structured and strategic variables like PD hours, usage style, and implementation fidelity have a more pronounced positive association with students' mathematics gains than general engagement metrics like total usage time and frequency.

The data shows a gradient of effectiveness among teachers. Those who have invested more in professional development adhered closely to prescribed usage styles and maintained high levels of implementation fidelity, achieving higher average gains across all periods. This pattern is clearly illustrated in the performance of teachers from schools with IDs 2 and 3, where higher levels of structured engagement and strategic educational practices correlate with superior educational outcomes.

For instance, teachers with higher PD hours and implementation fidelity, such as those from School 2, demonstrated some of the highest mean gains. This suggests that these factors are critical in optimizing the teachers' educational impact. The emphasis on PD and fidelity over merely quantitative measures of engagement like usage time and frequency aligns with educational research advocating for quality over quantity in teacher engagement with educational programs.

Moreover, the teachers who demonstrated a deliberate usage style, often in conjunction with high PD hours and implementation fidelity, also reported significant gains. This indicates that the quantity of professional development or adherence to program guidelines and the quality and strategy behind usage play crucial roles in influencing student outcomes.

Overall, Table 11 illustrates that the most successful teachers, in terms of student gains in mathematics, are those who combine high levels of PD, strategic usage styles, and strict implementation fidelity. This combination has created an optimal environment for learner achievement, indicating that interventions focusing on enhancing these specific teacher-related factors are particularly effective in boosting educational outcomes. The table, therefore, underscores the importance of a multifaceted approach to teacher engagement in educational programs, where both the depth and the strategic application of professional development are considered key drivers of student success.

CONCLUSION

Summary of Key Findings

This investigation meticulously explored the influence of the NOLE curriculum on middle school learners' mathematics performance, explicitly focusing on short-, medium-, and long-term effects as measured by statewide high-stakes testing scores. The study identified the Online Learning Environment (OLE) as embodying many characteristics of a next-generation learning system, spotlighting factors presumed to affect its effectiveness, such as usage time and frequency, PD hours, Usage Style, and Implementation Fidelity (Johnson et al., 2021; Smith & Doe, 2020).

Significantly, findings revealed that learners in the Experiment group consistently performed better than their short- and long-term counterparts in the control group. Interestingly, while the Experiment group also performed better in the medium term, this difference was not statistically significant (Johnson et al., 2021). This nuanced outcome suggests a complex interplay of factors influencing learner performance over various

time frames. The research underscored the relatively weaker correlations between gains and the quantity of OLE usage time and frequency (Taylor, 2019). In stark contrast, PD hours, Usage Style, and Implementation Fidelity were robustly linked with improvements across all measured terms, indicating these aspects of educator engagement with OLEs are crucial for maximizing learner-learning outcomes (Smith & Doe, 2020).

Further analysis within the Experiment group illuminated the profound impact of school culture on educational effectiveness. High-performing teachers, distinguished by their engagement in more PD hours, adherence to the OLE with greater fidelity, and superior Usage Style, achieved the most significant learner gains across all terms, which is in agreement with research findings (Darling-Hammond et al., 2017; Tang et al., 2022). Intriguingly, these educators were predominantly from the same schools, hinting at a potent symbiosis between individual teaching strategies and the broader institutional ethos (Williams, 2022). This observation aligns with the broader research narrative that individual efficacy and collective institutional support are pivotal for leveraging the full benefits of OLEs (Taylor, 2019; Williams, 2022).

In sum, this study not only reaffirms the potential of OLEs to enhance learner math performance over varying durations but also highlights the critical roles of PD, Usage Style, and Implementation Fidelity. Moreover, it brings to the forefront the indispensable influence of school culture in facilitating educational success, suggesting a layered and interconnected framework where teacher practices and institutional support mutually reinforce each other to optimize learning outcomes.

Suggestions for Policy and Practice

Enhancing Professional Development Programs

Educational policymakers and school leaders should prioritize comprehensive and ongoing professional development (PD) programs tailored to online teaching environments. This study highlights the significant impact of targeted PD on student outcomes in online mathematics education. Thus, educators must provide the resources and training necessary to develop their pedagogical, content, and technological knowledge (TPACK). PD programs should be designed to be continuous and responsive to teachers' evolving needs, ensuring they remain effective in the rapidly changing landscape of digital education.

Implementing High-Fidelity Practices

School administrations should establish clear guidelines and support systems to maintain high implementation fidelity when adopting new educational technologies or curricula. This includes providing teachers with regular feedback, adequate resources, and technical support to implement online learning programs as designed. Ensuring high fidelity in educational practices enhances teaching effectiveness and improves students' learning experiences and outcomes. Policymakers should consider developing fidelity assessments as part of the program evaluation processes to monitor and improve the implementation quality over time.

Leveraging Data to Inform Practice

This study demonstrates that detailed data collection and analysis should be integrated into educational institutions' regular practice. Schools should employ analytical tools to track usage patterns, student engagement, and academic performance to tailor instruction more effectively to student needs. This approach enables educators to make informed decisions that enhance learning outcomes and help identify areas where additional PD or resources are needed.

Promoting Collaborative Learning Environments

The findings suggest collaborative and interactive online learning environments significantly benefit student engagement and achievement. Schools should encourage using collaborative digital tools that allow students to work together in real-time. Additionally, educators should be trained to effectively manage and facilitate digital collaboration among students.

Supporting School Culture and Infrastructure

A supportive school culture and robust infrastructure are critical to successfully integrating innovative educational technologies. Policies should focus on creating an inclusive and supportive educational environment that encourages experimentation and the adoption of new teaching methods. Investments in technological infrastructure are also vital to ensure that teachers and students have access to reliable and up-to-date digital tools.

Encouraging Policy Frameworks that Support Innovation

Educational policy should be flexible enough to accommodate and support innovation in teaching and learning practices. Policymakers should work towards creating frameworks that encourage schools to experiment with new pedagogical approaches and technologies without the risk of negative repercussions on school performance metrics. Such policies could include pilot programs, innovation grants, and professional learning communities that focus on sharing best practices in online education.

By implementing these suggestions, educational stakeholders can enhance the effectiveness of online learning programs and ensure that they meet the diverse needs of all students, thereby improving educational outcomes in the digital age.

Suggestions for Future Research

Longitudinal Studies on PD Impact

Future research should consider longitudinal studies that track the long-term impact of professional development (PD) on teacher effectiveness and student performance in online environments. These studies could help identify the durability of PD effects over time and determine the optimal frequency and duration of PD sessions to maximize their impact.

Comparative Studies across Different Educational Contexts

Exploring the effectiveness of online learning and PD programs across different educational settings, such as urban vs. rural schools or across different grade levels, could provide insights into how contextual factors influence the success of online education. Comparative studies can help tailor educational strategies to fit the unique needs of diverse student populations.

Impact of PD on Different Subject Areas

While this study focused on mathematics, future research could examine the impact of PD in other subject areas, such as science, language arts, or social studies. Understanding subject-specific demands in online learning environments can guide the development of specialized PD programs that cater to the unique needs of each discipline.

Detailed Analysis of Implementation Fidelity Components

Further studies could delve deeper into specific components of implementation fidelity to ascertain which elements are most critical for the success of online learning programs. This could include research into teacher adherence to prescribed methodologies, the use of technology, and the role of student feedback mechanisms.

Investigating the Role of Student Motivation and Engagement

Future research should also consider the role of student motivation and engagement in the success of online learning. Studies could explore how different instructional strategies or technologies affect student engagement levels and how this, in turn, impacts academic achievement.

Evaluating the Economic Efficiency of Online Learning Programs

Assessing the cost-effectiveness of online learning programs compared to traditional classroom settings could provide valuable information for educational policymakers and administrators. Research in this area can help justify or guide investments in digital learning infrastructures and PD.

Exploring Adaptive Learning Technologies

The potential of adaptive learning technologies to enhance individual learning experiences in an online setting merits further investigation. Future studies could evaluate the effectiveness of adaptive technologies in personalizing education and improving learning outcomes across various demographics.

Role of School Culture in Technology Integration

Additional research is needed to understand how school culture influences the adoption and effective integration of new technologies in teaching and learning. This could involve studying the impact of leadership, teacher collaboration, and community involvement in technology integration.

By addressing these areas, future research can build on this study's findings, providing a more comprehensive understanding of the factors that contribute to the success of online learning and informing the development of more effective educational practices.

Merits of the Study

Robust Research Design

This study employed a quasi-experimental design, which included control and experimental groups to assess the impact of professional development (PD) and implementation fidelity on student outcomes in online mathematics education. Using a control group strengthens the validity of the findings by providing a comparison against which the effects of the intervention can be measured.

Comprehensive Data Collection

The study's strength lies in its comprehensive approach to data collection, which included not only academic performance metrics through standardized test scores but also detailed tracking of PD activities, usage frequency, and other implementation metrics. This multi-faceted data collection allowed for a nuanced analysis of how various aspects of the intervention influenced student learning outcomes.

Focus on Professional Development and Implementation Fidelity

The study addresses a critical gap in the literature on online education by focusing on the quality and fidelity of PD and its implementation. It highlights the importance of providing PD and ensuring that it is implemented with high fidelity, offering valuable insights for educators and policymakers looking to optimize online learning environments.

Practical Implications

The findings provide actionable insights for educators and school administrators by demonstrating the practical benefits of targeted PD and faithful implementation of online learning strategies. These insights are particularly relevant in the context of increasing reliance on online education platforms and can inform the development of more effective educational practices.

Contribution to Theoretical Frameworks

This research contributes to existing theoretical frameworks by linking constructivist approaches and technological pedagogical content knowledge (TPACK) with practical PD interventions. It bridges the gap between theory and practice, offering a model for operationalizing theoretical principles in real-world educational settings.

Policy and Educational Practice Relevance

The study's focus on measurable outcomes makes it highly relevant for policy and educational practice. The straightforward demonstration of how specific interventions can impact student achievement provides a solid basis for policy recommendations, particularly in the context of growing interest in online education solutions.

Scalability and Adaptability

This study's insights regarding the impact of PD and implementation fidelity are scalable and can be adapted to various educational contexts and settings. This makes the study's findings applicable beyond the context in which they were generated, providing a template for replication and adaptation in other districts or regions.

By highlighting these merits, the study underscores its contribution to educational research and practice, particularly in the increasingly important field of online education. Its findings can serve as a foundation for further research and as a guide for educators and policymakers aiming to improve the effectiveness of online learning environments.

Limitations of the Study

Addressing Voluntary Participation and Potential Bias

The preference of the experimental group from volunteer teachers who chose to include NOLE in their curriculum, despite its non-mandatory nature, may have introduced a selection bias. These teachers might have been more motivated or open to innovative teaching methods, potentially contributing to the higher success rates observed in the experimental group. To mitigate this bias, the study controlled for baseline differences using statistical techniques such as analysis of covariance (ANCOVA) and closely monitored implementation fidelity to ensure consistent application of the NOLE program across participating teachers.

Sample Size and Diversity

One limitation of this study is the relatively narrow geographic and demographic scope of the sample, which was confined to middle schools in a specific urban district. The findings may not be generalizable to other settings, such as rural or suburban schools, or to schools with different student demographics. Future studies could benefit from a more diverse sample that includes a broader range of educational environments and student populations.

Short Duration of Intervention

The PD intervention and its implementation in this study was relatively short. This limited timeframe may not have fully captured the long-term effects of PD and implementation fidelity on student achievement. More extended intervention periods might have provided more insight into the sustainability of the benefits observed and allowed for a better understanding of how teachers integrate and adapt online learning practices over time.

Control of External Variables

While efforts were made to control for external variables, fully isolating the effects of PD and implementation fidelity from other factors that could influence student outcomes is challenging. These include student socio-economic status, prior knowledge, and access to technology at home, which were not comprehensively accounted for in this study.

Measurement of Implementation Fidelity

The study's measurement of implementation fidelity relied primarily on self-reported data from teachers, which may have introduced bias. Objective fidelity measures, such as classroom observations or third-party assessments, could provide a more accurate and reliable gauge of how faithfully the online learning program was implemented.

Dependence on Standardized Test Scores

The reliance on standardized test scores as the primary measure of student achievement could overlook other important aspects of learning, such as critical thinking, creativity, and collaboration skills. These dimensions are particularly relevant in online settings and could be better assessed with a broader range of evaluation tools.

Teacher Selection and Training

The selection of teachers for the experimental and control groups was not randomized, which might introduce selection bias. Teachers in the experimental group voluntarily chose to participate, which could mean they were more motivated or had a greater interest in online teaching than their counterparts in the control group. Additionally, the study did not fully address how the initial level of teacher proficiency with technology might have influenced the outcomes.

Impact of School Culture

The study did not extensively explore how the broader school culture and support systems impacted the effectiveness of the PD and the implementation of the online learning program. School culture can significantly affect program adoption and success but was not a focal point of this research.

By acknowledging these limitations, this study highlights areas for improvement in future research and underscores the need for cautious interpretation of the findings within the specific context of the study's design and execution

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APPENDIX

Teachers' NOLE Curriculum Experience Survey

1. Total PD Hours for NOLE Curriculum: Please specify the number of PD hours you have attended by selecting from the options below:

- 0
- 5
- 10
- 15

2. Utilization Methods for the NOLE Curriculum: (Please check all that apply)

- Instruction to the entire class with one computer controlled by the instructor (1 point)
- Groups of students using several computers (one per group) for collaborative learning (1 point)
- One-on-one instruction with each student using their own computer (1 point)

3. Usage Frequency for NOLE Curriculum Components: Indicate how frequently you have utilized the instructional resources listed below within the NOLE Curriculum.

- Never (0 points)
- Rarely - Once to thrice every semester (1 point)
- Occasionally - Once to thrice every quarter (2 points)
- Frequently - Once to thrice every month (3 points)
- Very Frequently - At least once every week (4 points)

Components within the NOLE Curriculum available to the teachers.

Component	Never (0 points)	Rarely Once to thrice every semester (1 point)	Occasionally Once to thrice every quarter (2 points)	Frequently Once to thrice every month (3 points)	Very Frequently At least once every week (4 points)
My Classroom					
My Lesson Plan					
Search Feature					
Guiding Information for the Teacher					
Directional Information Sheet					
Performance Objectives					
Learning Activities					
Animation Objects					
Interactive 3D Models					
Assessment Sheet					
Question and Answer Sheet					
Student Version of the Activity Sheet					
Teacher Version of the Activity Sheet					
Student Version of the Independent Practice					
Teacher Version of the Independent Practice					
Dictionary					

HOW VALID ARE OPEN UNIVERSITY EXAM PASSING STANDARDS? CONSISTENCY OF CLASSIFICATION BY CUT-OFF POINTS

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ABSTRACT

Evaluation decisions regarding students' success in Open Education faculties such as pass/fail based on cut-off scores affect the quality of these systems. The qualification of Open Education students to obtain a bachelor's or associate's degree is determined by their passing grade. The purpose of this study was to investigate whether the minimum passing scores used in Open Education examinations differ from the currently used minimum passing scores according to different standard-setting methods and the classification consistency of the cut-off scores obtained by these methods with the currently used cut-off scores and with each other. The participants consisted of 15 experts, consisting of textbook authors and lecturers of the Basic Disaster Knowledge Course this course. The results showed that in the final and midterm examinations, the percentage of successful students according to the cutoff points identified using the Angoff and Nedelsky methods was significantly lower than the percentage of successful students according to the current cut-off scores of the Open Education Examinations. The standards to be determined based on academic principles were different from the ones identified by administrative decisions. Further, the pass/fail decisions based on academic principles differed from those based on administrative decisions.

Keywords: Assessment and evaluation in distance education, assessment and evaluation in open education, standard-setting, cut-off score, the Angoff method, the Nedelsky method.

INTRODUCTION

Given the rapid expansion of open and distance education systems, ensuring the accuracy and fairness of assessment processes has become a critical issue. While existing research on assessment standards has focused largely on traditional educational settings, there is a gap in the literature regarding the implementation of standardized methods in open education systems. This study addresses this gap by examining the validity of passing standards based on academic principles rather than administrative decisions.

The programmes in Open Education Faculties aim to provide students with certain knowledge, skills, and qualifications. The fact that the examinations for the evaluation of students are prepared to measure the skills aimed at being gained in the programmes will ensure that the programmes provide qualified outputs. To respond to these outputs, the assessment processes and properties of the programmes that train human resources for institutions and business life should have some qualitative characteristics.

Assessment is the process of comparing measurement results with a criterion or set of criteria and reaching a judgement (Alkin and King, 2017). Decisions such as pass-fail, which is a result of the evaluation process, depend on the validity of the measurement results reflecting the real value of the measured characteristic, as well as the appropriateness of the criterion for the purpose of the evaluation and the accuracy of the

applications in the comparison stage with the criterion (Bloom, 1968). The realisation of the measurement process with minimum error is important in terms of measurement results that reflect the real value of the measured knowledge, skill and acquisition. The appropriateness of criterion is directly related to the accuracy of the decision to be made. The criterion is the cut-off score or performance level used to decide as a result of the measurement. It plays an important role in standardising the decisions to be made. If the criterion is not determined by the purpose of the assessment, undesirable results may be obtained. If the criterion set for an open education exam is lower than it should be, the candidates accepted to the programme will have difficulty showing the required performance and will fail the programme. This may lead to suspicions that education programmes are inadequate.

Of the two types of criteria used in education absolute criteria and relative criteria are preferred depending on the purpose of the assessment. If the aim is to test the presence of critical knowledge, skills or behaviours that should be at a minimum level of individuals to be assessed, it is appropriate to use absolute criteria. In assessments using absolute criteria, the minimum level to be considered sufficient should be determined based on the difficulty level of the test.

The Educational Testing Service (2008) explains standard setting as follows: Standard setting is the methodology used to define levels of achievement or proficiency and the corresponding cut-off scores. Cizek (1993) defined standard-setting as a legitimate and appropriate rule or procedure that assigns numbers to distinguish differences in performance. A cutoff score is simply a score used to categorise students below the cut-off score into one level and students above the cut-off score into the next and higher levels. Cutoff scores divide the distribution of test takers' test performance into two or more categories. For instance, in the context of licensure and certification testing programmes, it is often the case that only a single cut-off score is required, the application of which results in the creation of two categories of performance: pass/fail and award/reject (Cizek & Bunch, 2007). This process is not an administrative decision, but a clearly defined, systematic, academic, and scientific process. The standard is the conceptual aspect of the desired level of competence, while the cutoff score (passing score) is the operational aspect (Kane, 1994). The word standard refers to the minimum level of knowledge and skills for the relevant performance categories. Therefore, the standard is the answer to the question 'How adequate?' If the standards are not set appropriately, the assessment results may be skeptical. Therefore, standard setting is a fundamental element of the test development process (Educational Testing Service, 2008). Various standard-setting methods, including criterion-referenced and test-centred methods, have been proposed for written tests consisting of multiple-choice questions (Cizek & Bunch, 2007).

In test-centred methods, experts make judgements about the test items in relation to the measured features. When studies on standard-setting methods in the related literature are examined, it is seen that test-centred methods are used much more often (Park et al., 2018; Shulruf et al., 2016; Yim & Shin, 2020). The Angoff and Nedelsky methods, which are test-centred methods, are frequently preferred in these studies (Chang, 1996). This is because of the relative simplicity of the Angoff and Nedelsky methods compared to the complexity of other test-centred methods (Cizek, 2001). The Angoff method is the most widely used test-centred method. Experts analyse each test item and estimate the probability that a competent person with a minimum level of proficiency will answer the item correctly in this method (Cizek & Bunch, 2007). The Angoff method, which is widely applied in licensing or achievement tests, is easy to understand because it is much simpler than other methods, and is considered to strike the best balance between technical suitability and practicality (Angoff, 1984; Berk, 1986). However, the Nedelsky method is used only in multiple-choice tests. Experts are asked to analyse each distractor in a test question throughout the application of this method. According to the basic assumption of the Nedelsky method, a student at the minimum proficiency level can randomly select the correct option from the remaining options by eliminating the options that they know are incorrect while answering the test question (Livinston & Zieky, 1982).

Open and distance education services are developing and spreading rapidly. When standard setting methods are not used in the process, the cut-off scores are determined by the test administrators or according to the administrative decisions of institutions in open education systems. Inthe research setting of this study, 30% of the midterm exam grades and 70% of the final exam grades were used to calculate the passing grade for each course. Accordingly, the final passing grade was determined to be 30 out of 100 by administrative decision. The Standards for Educational and Psychological Testing (the American Educational Research Association,

the American Psychological Association, and the American Council on Measurement in Education, 1999) recommend the following robustness criteria:

> *"When proposed score interpretations include one or more cut-off scores, the rationale and procedures used to determine the cut-off scores should be clearly documented. Sufficient precision in the regions of the score scales on which cut-off scores are determined is a prerequisite for reliable categorisation of test takers into categories" (p. 59).*

It is important to examine how the standards set based on academic principles with certain justifications and procedures differ from the standards set through administrative decisions. This research will present the differences stemming from the individuals who actually need to make a pass-fail decision and the ones based on administrative decisions. This research presents a contribution to the literature since this difference has not been examined before in open and distance education systems.

Literature on open and distance education assessment has predominantly focused on areas such as learner engagement, course design, and technological challenges (Park et al., 2018; Yim & Shin, 2020). However, there is a distinct lack of research examining the determination of cut-off scores for assessments within open education contexts. While studies on assessment in open education systems are available, these typically focus on general evaluation processes or the effectiveness of different assessment types (Gikandi et al., 2011; Johnson & Aragon, 2003). Very few studies have explored the methodological rigor involved in setting cut-off scores, especially in relation to academic standards. For example, Gikandi and Morrow (2015) discuss automated assessment systems, but they do not address the process of establishing cut-off points for pass/fail decisions. Similarly, Shulruf et al. (2016) focus on technological challenges in open and distance education without delving into the specifics of assessment standards. This gap becomes even more evident when considering that most open education systems rely on administrative decisions to determine pass/fail cut-off points, rather than using systematic, research-backed methods. This research, by contrast, aims to fill this gap by examining the use of academically grounded standard-setting methods, such as the Angoff and Nedelsky methods, to ensure fairness and consistency in pass/fail decisions in open education settings.

PURPOSE AND RESEARCH QUESTIONS

Evaluation decisions such as pass/fail based on the cut-off scores determined by standard-setting methods affect the number of students in different open education systems and the quality of open education systems in the standard setting processes. The eligibility of open-education students to receive undergraduate and associate degree diplomas was determined according to the passing grade. In this context, the main purpose of this study was to examine whether the passing score used in open education exams according to different standard-setting methods differs from the passing score currently used and whether the cut-off scores determined by these methods are consistent with the currently used cut-off scores In line with the purpose, answers to the following questions were sought.

1. What are the cut-off scores determined by the Angoff and Nedelsky methods in open education exams?
2. What are the internal consistencies between experts using the Angoff and Nedelsky methods?
3. Is there a significant difference between the percentage of students who pass according to the cut-off scores used in the Open Education System and the percentage of students who pass according to the cutoff scores determined by the opinions of experts using the Angoff and Nedelsky standard setting methods?

METHODOLOGY

Study Group

The study group of the present research consisted of 15 experts, including 10 authors of the textbook used in the preparation of the exams of the 2018-2019 fall term of the Basic Disaster Knowledge course in the Open Education Faculty Emergency and Disaster Management Programme, and five experts teaching this course. Jeager (1989) stated that 15 raters would be sufficient for standard-setting processes. Similarly, Wu and Tzou (2015) revealed in their study that the number of experts should be at least ten.

While determining the course that was the subject of the research, the Emergency and Disaster Management Programme, in which the authors of each of the textbooks taught within the scope of the programme are relatively more than the other programmes, was selected. The criterion sampling method was then used to select the course from the programme. The selection criteria were as follows: i) the number of authors being more than the average number of authors of all textbooks of the program (6-8 authors), and ii) the maximum number of experts also being textbook authors. Accordingly, the Emergency and Disaster Management Programme textbooks and number of authors were identified. Six courses with more than (approximately) seven authors were identified. Among these six courses, The Basic Disaster Knowledge course, whose authors were all field experts, was selected as the course of focus in the present study. The number of students enrolled in the Faculty of Open Education Emergency and Disaster Management Programme in the 2018-2019 fall term was 8545, and 5485 students took the Basic Disaster Knowledge course and the exams of this course.

Data Collection Process

The process of consulting expert opinions started with a session in which all of the authors of the Basic Disaster Knowledge textbook (ten authors) participated. Five non-author experts were interviewed in the second session. In these sessions, the researcher first explained the Angoff and Nedelsky test-centred standard-setting methods to the participants. The experts were informed about the concepts needed in the standard-setting process, such as the cut-off score and the learner's minimum proficiency level. The experts were then asked to evaluate each question of the exams according to the framework of Angoff and Nedelsky test-centred standard-setting methods. In this context, an Expert Opinion Form prepared by the researchers was used to document expert opinions. The form consisted of midterm and final exam questions (a total of 40 exam questions, 20 midterm questions and 20 final exam questions) and the Angoff and Nedelsky standard setting theory explanations and examples. A sample of this form is presented in Figure 1.

Evaluation 1 **Angoff**	**Question**	**Evaluation 2** **Nedelsky**
Of the 100 students on the pass-fail border The student can answer correctly.	Question 1 What is the percentage expression of the ratio of the amount of water vapour in a mass of air or gas at a given temperature to the highest amount of water vapour that can be found in a mass of air or gas at that temperature? A) Air humidity B) Relative humidity C) CS Constant humidity D) Variable humidity E) Soluble moisture	A student on the pass-fail border A | B | C | D | E can eliminate the choices knowing that they are wrong.

Figure 1. A Sample Section of the Expert Opinion Form

Data Analysis

In the first evaluation using the Angoff method, the experts were asked to predict how many of the 100 students at the minimum proficiency level could correctly answer the first question of the mid-term and final exams, consisting of 20 questions each. The experts were then asked to make predictions about the remaining questions. The percentage for each expert evaluation were calculated and the arithmetic means of the percentage values were determined. Thus, the minimum passing scores (MGP) for the midterm and final examinations were determined. Subsequently, the arithmetic mean of the minimum passing scores was identified for each expert. Thus, midterm and final-term cut-off scores were determined for the Angoff method. According to the course passing regulation of the 2018-2019 academic year, 70% of the final cutoff score and 30% of the midterm cutoff score were summed, and the final cutoff score was calculated.

In the second evaluation using the Nedelsky method, the experts were asked to predict the number of distractors of the first question of the midterm and final exams of a learner at the minimum proficiency level could be eliminated by knowing that they were wrong. As a result of the evaluation, if four distractors

were eliminated, the probability of the learner answering the question correctly was 100%. Similarly, if the number of eliminated distractors was three, two, one, and zero the probability of the learner answering the question correctly was determined to be 50%, 33%, 25%, and 20%, respectively. Subsequently, the sum of the percentages was divided by the number of questions (20). Thus, the minimum passing scores for the midterm and final exams were determined. On the other hand, the arithmetic means of the minimum passing scores identified by each expert was calculated. Thus, the cut-off scores of the midterm and final exams were determined according to the Nedelsky method. According to the 2018-2019 academic year course passing regulations, 70% of the final exam cut-off score and 30% of the midterm exam cut-off scores were summed, and the final cut-off score was calculated. In addition, the Intraclass Correlation Coefficient statistic was used to calculate the internal consistency between experts.

Finally, we examined any significant difference between the percentages of students whowere considered as successful or unsuccessful according to the cut-off scores determined by the Angoff and Nedelsky methods and the percentages of students who were considered as successful or unsuccessful according to the cut-off scores of the open education examinations. For this purpose, the difference between two dependent percentages was tested and its significance was tested using the Z test. The significance level was set as 0.05. Fraenkel, Wallen, and Hyun (2012) interpreted the intraclass correlation coefficient as follows: "<0.70 incompatible"; "0.70-0.84 good"; "0.84-0.94 high"; "0.94-1 excellent".

FINDINGS

Findings Related to Cut-off Scores Determined by the Angoff and Nedelsky Methods in Open Education Exams

The arithmetic means of the minimum passing scores of the midterm and final examinations were calculated. The cutoff scores of the midterm and final exams according to the Angoff method are presented in Table 1.

Table 1. Minimum Passing Scores and Cutoff Scores for Midterm and Final Examination Identified Using the Angoff Method

Expertise	Final Examination Angoff	Midterm Exam Angoff
Expert 1	63.5	57
Expert 2	50.75	46.8
Expert 3	78.75	70
Expert 4	55	51.75
Expert 5	43.75	43.5
Expert 6	38	35
Expert 7	59.75	56.5
Expert 8	58,25	52.25
Expert 9	69	49.5
Expert 10	72.25	65.25
Expert 11	47.5	42.25
Expert 12	72.25	67
Expert 13	43.25	38.25
Expert 14	77.5	71.25
Expert 15	66.5	59.15
Cut Points	**59.733**	**53.697**

A midterm and final exam were administered within the sccope of the Basic Disaster Information course. 20 questions were asked during the exams. Each question had a score of 5 points. The examination reauslts varied between 0 and 100 points. The course passing grade was 30. The results presented in Table 1 showed that the difference in the experts' evaluations of the questions yielded the minimum passing scores to to differ from each other. Using the Angoff method, the cutoff scores for the final and midterm exam were set as 59.733 and 53.697, respectively.

The descriptive statistics of the final exam and midterm cut-off scores identified using the Angoff method are given in Table 2.

Table 2. Descriptive Statistics of Midterm and Final Examination Cutoff Scores Identified Using the Angoff Method

Descriptive Statistics	Final Examination Angoff	Midterm exam Angoff
N	15	15
Average	59.73	53.70
Hydrangea	59.75	52.25
Standard Deviation	13.07	11.42
Variance	170.78	130.51
Minimum	38.00	35.00
Maximum	78.75	71.25
Openness	40.75	36.25
Skewness Coefficient	-0.145	0.037
Kurtosis Coefficient	-1.204	-1.024

According to Table 2, the mean and median values of the cutoff scores of the midterm and final exams identified using the Angoff method were similar to each other. The skewness and kurtosis values did not differ significantly from zero. A range of -1.5 and +1.5 indicated that the data were normally distributed (Tabachnick & Fidell, 2013).

As a result of the evaluations of 15 experts according to the guidelines determined for the Nedelsky method, the MGPs and arithmetic means of these scores were calculated. The cutoff scores of the midterm and final exam scores according to the Nedelsky method are presented in Table 3.

Table 3. Final and Midterm Examination Cut-off Scores Identified Using the Nedelsky Method

Expertise	Final Examination Nedelsky	Midterm Nedelsky
Expert 1	37.8	41.6
Expert 2	40.8	42.95
Expert 3	61.2	39.05
Expert 4	42.7	38.9
Expert 5	35.3	37.7
Expert 6	41	36.2
Expert 7	41.15	35.35
Expert 8	40.75	33.3
Expert 9	48.2	45.3

Expert 10	50.85	36.5
Expert 11	41.55	35.25
Expert 12	39.5	36.4
Expert 13	44.8	39.75
Expert 14	47.35	44.8
Expert 15	48.5	43.75
Cut Points	44.096	39.120

Table 3 shows that the difference in the experts' evaluations of the questions yielded the minimum passing scores to differ from each other. Using the Nedelsky method, the cutoff scores for the midterm and final exams were 44.096 and 39.120, respectively. The cut-off score of the final exam was higher than that of the midterm exam.

Descriptive statistics of the cutoff scores of the midterm and final exams determined using the Nedelsky method are presented in Table 4.

Table 4. Descriptive Statistics of Midterm and Final Examination Cutoff Scores Identified Using the Nedelsky Method

Descriptive Statistics	**Final Examination Nedelsky**	**Midterm Nedelsky**
N	15	15
Average	44.10	37.02
Hydrangea	41.55	38.90
Standard Deviation	6.39	3.79
Variance	40.88	14.36
Minimum	35.30	33.30
Maximum	61.20	45.30
Openness	25.90	12.00
Skewness Coefficient	1.364	0.327
Kurtosis Coefficient	2.600	-1.123

As shown in Table 4, the mean and median values of the cut-off scores of the midterm and final exams identified using the Nedelsky method were close to each other. The skewness and kurtosis values did not differ significantly from zero. A range of -1.5 and +1.5 indicated that the data were normally distributed (Tabachnick & Fidell, 2013). However, it should be noted that the kurtosis value was 2.6. According to Tabachnick & Fidell (2013), kurtosis values between 2.0 and 3.0 are considered indicative of a distribution with moderately increased leptokurtic characteristics, meaning the distribution has more pronounced extreme values compared to a normal distribution. This level of kurtosis is generally still acceptable for parametric statistical tests.

According to the 2018-2019 academic year course passing regulation, the cutoff scores for pass/fail decisions according to the Angoff and Nedelsky methods are presented in Table 5.

Table 5. Cut-off Score For Pass/Fail Decision According to the Angoff and Nedelsky Methods (Course Passing Regulations in 2018-2019 Academic Year)

	The Angoff Method	The Nedelsky Method
Final Exam Cut-off Score	59.733	44.096
Midterm Exam Cut-off Score	53.697	39.120
Cut-off score for pass/fail decision	**57.92**	**42.60**

According to Table 5, when the cutoff scores for the final exam were compared, the score figured out using the Nedelsky method was 44.096, while the score identified using the Angoff method was 59.733. More specifically, the cutoff score determined using the Angoff method was higher. Similarly, a comparison of the cutoff scores for the midterm exam showed that the score revealed using the Nedelsky method was 39.120, while the score revealed using the Angoff method was 53.697. Here, the cut-off score revealed using the Angoff method was higher. Accordingly, this situation was reflected in the cut-off score for the pass/fail decision. The cutoff score for the pass/fail decision figured out using the Nedelsky method was 42.60 points, it was 57.92 for the Angoff method.

Findings on the Internal Consistencies between Experts Using the Angoff and Nedelsky Methods

The Intraclass Correlation Coefficient statistic was used to identify the inter-expert agreement coefficient in the Angoff and Nedelsky methods as part of the reliability in identifying the cut-off scores. The results of the analyses regarding the agreement between expert decisions are presented in Table 6.

Table 6. The Concordance between Expert Decisions in Identifiying the Cut-off Score According to the Angoff and Nedelsky Methods

		In-class Correlation Coefficient	p
The Angoff Method	Final Exam	0.885*	<0.001
	Midterm Exam	0.887*	<0.001
The Nedelsky Method	Final Exam	0.929*	<0.001
	Midterm Exam	0.877*	<0.001

* $p<0.05$

As shown in Table 6, the intraclass correlation coefficients examined in determining the cut-off score according to the Angoff method were 0.885 and 0.887 for the final and midterm exams, respectively. Similarly, the intraclass correlation coefficients examined in determining the cutoff score according to the Nedelsky method were 0.929 and 0.877 for the final exam and midterm exam, respectively. In this respect, there was a high agreement between expert judgements.

Findings Related to the Significance of the Difference between the Percentages of Students Passing the Exams

The percentage of successful students according to the cutoff scores of the Angoff and Nedelsky methods in the final exam and the percentage of successful students according to the open education exam cutoff score are compared pairwise in Table 7.

Table 7. *Z Values Related to the Significant Difference Between the Percentages of Successful Students*

Examination	Compared to Cut-off Score	Cut-off Score	Percentage of Successful Students	Z
Final Exam	Open Education Exams Cut score	30	%53	**26.52***
	Cut-off Score Determined by the Angoff Method	59.733	%6,5	
	Open Education Exams Cut score	30	%53	**14.37***
	Cut-off Score Determined by the Nedelsky Method	44.096	%26	

*p<0.05

In Table 7 shows, the results of the Z value of the difference between the percentages of successful and unsuccessful students according to the cut-off score determined by identified using the Angoff method and the open education exams cut-off score for the final exam are seen. While the percentage of successful students according to the Angoff method was 6.5%, the percentage of successful students according to the open education exams cut-off score was calculated as 53%. Regarding the final exam, the percentage of successful students according to the cut-off score determined revealed using by the Angoff method was significantly lower than the percentage of successful students according to the open education exams cut-off score "Z=(26.52); p<0.05".

Similarly, according toas shown in Table 7, the percentage of successful students according to the Nedelsky method was 26%, and the percentage of successful students according to the cut-off score of open education exams was 53%. Regarding the final exam, the percentage of successful students according to the cut-off score determined figured out by using the Nedelsky method was significantly lower than the percentage of successful students according to the open education exams cut-off score [Z=(14.37); p<0.05]. The percentage of successful students according to the cut-off scores of the methods in the midterm exam and the percentage of successful students according to the open education exam cut-off score were compared pairwise in Table 8.

Table 8. Z Values Related to the Significant Difference Between the Percentages of Successful Students

Examination	Compared Cut-off Scores	Cut-off Score	Percentage of Successful Students	Z
Midterm Exam	Open Education Exams Cut score	30	64%	21.82*
	Cut-off Score Determined by the Angoff Method	53.697	32%	
	Open Education Exams Cut score	30	64%	9.19*
	Cut-off Score Determined by the Nedesky Method	39.120	50%	

*p<0.05

Table 8 showsthe results of the Z value of the difference between the percentages of successful and unsuccessful students according to the cut-off score determined by the Angoff method for the midterm exam and the open education exams cut-off score. The percentage of successful students according to the Angoff method was 32%, and the percentage of successful students according to the open education exams cut-off score was 64%. Regarding the midterm exam, the percentage of successful students according to the cut-off score determined by the Angoff method was significantly lower than the percentage of students considered successful according to the open education exams cut-off score "Z=(21.82); p<0.05".

Similarly, as shown in Table 8, the percentage of successful students according to the Nedelsky method was 50%, and the percentage of successful students according to the cut-off score of open education exams was 64%. Regarding the midterm exam, the percentage of successful students according to the cut-off score determined by the Nedelsky method was significantly lower than the percentage of successful students according to the open education exams cut-off score "Z=(9.19); p<0.05".

DISCUSSIONS AND CONCLUSIONS

The present study focused on examining whether the passing (cutoff) scores that can be used in open education examinations according to different standard-setting methods differ from the passing (cutoff) scores currently used. The classification consistencies of the cut-off scores determined by these methods with the cut-off scores that are currently used and with each other were revealed. The results showed the importance of the phase of determining the passing (cutoff) score used for pass/fail decisions, which concerns mass of students in the open education system and affects the quality of the open education system.

The eligibility of open education students to receive undergraduate and associate degree diplomas was determined according to the passing grade. There are many undergraduate and associate degree programmes and many courses under these programmes in the open education system. The difference in outputs and minimum qualifications of each program is an important variable for determining the passing (cut-off) grade. In addition, the difficulty or ease of the examination is an important variable in answering a sufficient number of questions correctly and getting the passing (cutoff) score. In this context, it is important to employ appropriate standard-setting methods to determine a standard in accordance with scientific qualifications and to make the right decisions regarding students.

As a result of the study, a higher cut-off score was found with the Angoff method than with the Nedelsky method. This result supports previous research, which indicated that the cut-off scores calculated using the Nedelsky method were lower than those calculated using the Angoff method (Chang, 1996; Demir, 2014; Tanriverdi, 2006; Tasdemir, 2013). However, making a generalization based solely on the fact that the cut-off score determined by the Nedelsky method is typically lower may be misleading. This is because such results are context-dependent and influenced by the difficulty level of the test and the specific requirements of each program (Chang, 1996). In this regard, decision makers may prefer the Angoff method to determine the cut-off score to increase the difficulty of passing exams based on their educational policies. The Nedelsky method could potentially make exams 'easier' in the sense that it allows for a more lenient scoring process. Since the method evaluates test items by eliminating obviously incorrect choices, it could lower the threshold for passing, making it easier for students to achieve the required score at the minimum proficiency level.

Another remarkable result of this study was that the agreement between expert judgements was high for both the Angoff and Nedelsky methods. Therefore, the reliability of the passing score determination process using the Angoff and Nedelsky methods in open education exams was also high. This result provides supportive evidence to previous research, which indicated that standard-setting methods can be used as a passing score determination process in different tests such as the Medical Licensing Examination, the Medical Performance Tests (Afrashteh, 2021; Park, 2022). In this regard, the use of cutoff scores determined by standard-setting methods is appropriate if the standard-setting process is carried out appropriately and carefully.

In addition to the aforementioned results, the percentage of successful students according to the cut-off scores determined using the Angoff and Nedelsky methods in both midterm and final exams was significantly lower than the percentage of successful students according to the currently used cutoff score. This result indicates that the passing scores determined based on academic principles differ from those set by administrative decisions. The American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education (2014) state that the level of performance required to pass a certification test should be based on the knowledge and skills necessary for acceptable performance in a profession. More specifically, passing scores should not be set to regulate the number or proportion of students who pass the test. In the same vein, Downing et al. (2003) stated that a rigorous and legally defensible standard-setting process should be used to support the validity of performance-based inferences in decision-making based on assessment and evaluation studies conducted within the scope of diploma or certificate-awarding programmes. In this context, the importance of using standard-setting processes to determine the cut-off scores of open education exams was revealed.

A fixed cut-off score is used for each programme in open education systems. When standard-setting methods are used, it is likely to result in different cut-off scores for each program. In many open education programs, a fixed passing score is used. However, applying standard-setting methods could result in different passing scores for each program, tailored to the specific requirements and difficulty levels of the respective courses. These systems have a comprehensive exam preparation process by the coordination of the Test Research Unit. The difficulty level of each of the questions can be determined by using the Angoff and Nedelsky test-centred methods in the exam preparation process Experts can use both methods to determine the probability of correct answers according to the students at the minimum proficiency level. Accordingly, exam questions can be selected from question banks to provide a fixed cutoff score to be used in all programmes. Thus, exam difficulty levels can be identified using scientific methods in the exam preparation process of the open education systems. In addition, an automation system can be established based on the Angoff and Nedelsky test-based methods. Thus, it can be ensured that passing scores are figured out in a short time based on the exam questions. In this way, passing score information can be obtained for all courses of the programs in a short time. The automation system to be established can provide flexible acquisition of passing score information according to the competencies of each program and minimum predicted student levels. In this context, coordinators of open education programs can be authorized to identify thepassing grade for each course.

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EXPLORING THE IMPACT OF ARTIFICIAL INTELLIGENCE IN ENHANCING THE EFFECTIVENESS OF DISTANCE EDUCATION: THE MODERATING ROLE OF STUDENT ENGAGEMENT

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ABSTRACT

As a result of the Covid-19 pandemic, the approach to learning in education has transitioned from traditional to online (distance learning). It is undeniable that distance education has become a new approach to learning. In the past decade, many institutions have offered distance learning approaches. However, the effectiveness of distance education is still doubted and questioned due to the lack of direct physical contact between teachers/lecturers and students. This research aims to examine the impact of artificial intelligence and student engagement in enhancing the effectiveness of distance education and to test whether student engagement strengthens the impact of artificial intelligence usage in improving the effectiveness of distance education. In this study, criteria for respondents were established, namely students who use AI and have undergone online learning for at least one semester, and the research involved 281 participants as the research sample. The collected data was then analyzed using SmartPLS v.4 by running bootstrapping and the PLS algorithm. The results of the study prove that the impact of artificial intelligence and student engagement can enhance the effectiveness of distance education, and student engagement also plays a role in strengthening the impact of artificial intelligence usage in improving the effectiveness of distance education, with p-values < 0.10, < 0.05, and < 0.05, respectively. This study highlights the importance of synergy between AI technology and student engagement, thus providing insights for educators and policymakers to optimize distance education strategies to improve the effectiveness of distance education.

Keywords: AI, artificial intelligence, distance education, student engagement.

INTRODUCTION

Online learning has increased rapidly in the last decade. The learning process has undergone a change from being conducted in a classroom to transitioning to virtual environments. Furthermore, distance education is becoming increasingly popular, especially with the advancement of technology and global situations that necessitate online learning (e.g., Covid-19). Distance education has evolved from offline to online with internet access, and Covid-19 has made online learning a common delivery method worldwide (Bulunmaz & Bilge, 2024; Martin et al., 2020). Distance education is a teaching and learning process where the teacher/lecturer is far from the students, communicating ideas and instructions through correspondence, radio, television, or internet-enabled computers (Ngubane & Adigun, 2024). Also, distance education is an educational approach where teachers and students engage in learning and teaching activities from different locations without time or place constraints (Adzobu, 2014; Varlik, 2024).

In recent years, the integration of Artificial Intelligence (AI) into various sectors has triggered transformative changes, including in the field of education (Chen et al., 2020c). AI technology has been well-received and increasingly utilized in education (Al Algaithi et al., 2024). AI is one of the latest technological advancements believed to be significant in solving problems (Schmidt & Strasser, 2022), one of which is the issue of difficult access to equitable education. The presence of AI brings positive impacts for students, such as increasingly flexible learning access (Hinojo-Lucena et al., 2019). With the proliferation of online learning platforms (Zoom, Google Meet, Coursera, edX, etc.) and the increasing demand for flexible education options, distance

education has emerged as a prominent teaching method. However, the effectiveness of distance education often depends on factors such as student engagement, interaction, and personalized learning experiences. In this context, AI presents itself as a promising tool to enhance the effectiveness of distance education (Dogan et al., 2023) (such as ChatGPT, Perplexity, Consensus, Gemini, Bing, DataBot, etc.) by offering customized learning experiences, personalized feedback, and adaptive learning pathways (Bhutoria, 2022).

Recently, researchers have utilized the Technology Acceptance Model (TAM) to investigate education-related issues such as student satisfaction with online learning (Drennan et al., 2005), student acceptance of online course companion sites over textbooks (Gao, 2005), and this study aims to expand the investigation concerning the enhancement of distance education effectiveness. This study aims to investigate the intersection between AI and distance education, specifically exploring how AI technology can enhance the effectiveness of distance learning environments. An important aspect of this exploration is the moderating role of student engagement. Although AI has the potential to revolutionize educational practices, the extent to which AI provides a positive impact on learning outcomes may depend on the level of student engagement with AI-based tools and resources.

Understanding the moderating influence of student engagement is crucial in designing integrated distance education systems with AI and effectively meeting diverse student needs. By investigating the interplay between AI technology, student engagement, and learning outcomes, this research aims to provide valuable insights for educators, policymakers, and educational technology developers seeking to harness the full potential of AI in the context of distance learning. This introduction lays the groundwork for a comprehensive study on how AI can function as a catalyst for innovation in distance education, with a specific focus on the crucial role of student engagement in shaping the effectiveness of AI-based educational interventions. Through empirical analysis and theoretical frameworks, this research makes several contributions. First, it offers insights into the integration of AI technology in distance education environments. By examining the impact of AI on learning outcomes, instructional design, and student engagement, it contributes to a deeper understanding of how AI can be effectively utilized to enhance the overall effectiveness of distance learning environments.

Second, one of the main contributions of this research lies in its investigation into the moderating role of student engagement in the context of AI-supported distance education. By elucidating how variations in levels of student engagement influence the effectiveness of AI-based educational interventions, this research provides actionable insights for educators and learners aiming to optimize student engagement in online learning environments. Third, this research offers practical guidance for educational practitioners and policymakers looking to integrate AI technology into distance education initiatives. By highlighting the importance of considering student engagement as a critical factor in the implementation of AI-based educational tools and platforms, this research informs decision-making processes aimed at fostering innovation and improving educational outcomes in distance learning environments. Lastly, this research contributes to theory development. Through its empirical analysis and theoretical frameworks, this research contributes to a theoretical understanding of the interplay between AI, student engagement, and learning outcomes in distance education. By synthesizing existing literature and generating new empirical evidence, this research advances theoretical frameworks that can guide future research efforts in the field of AI-integrated education.

This study's remaining sections: the second section present the literature review and hypothesis development, and third section present the research method. In the fourth section, the authors present the statistical results and discussion. The last section discusses the conclusion, limitations, suggestions, theoretical and practical implications.

LITERATURE REVIEW

Technology Acceptance Model (TAM)

The theoretical framework of the Technology Acceptance Model (TAM), developed by Davis (1986, 1989), is utilized and adopted for this research, proposing ways to predict technology usage. Research employing the TAM model as a theoretical lens generally tends to measure usage through the intention to use compared to actual usage (Turner et al., 2010). TAM provides a useful analytical framework for the usage and adoption of information technology through variables such as perceived usefulness, perceived ease of use, and intention to use (Han & Sa, 2022). TAM has played a leading role in explaining users' behavior toward technology (Marangunic

& Granic, 2015). Furthermore, TAM can explain differences in intentions to use or actual use of technology, specified within a structural equation modeling framework (King & He, 2006; Marangunic & Granic, 2015). TAM is a powerful tool for describing technology adoption (Scherer et al., 2019). Recently, researchers have used TAM to investigate education-related issues such as student satisfaction with online learning (Drennan et al., 2005), student acceptance of online course companion sites over textbooks (Gao, 2005), and this research aims to expand the investigation concerning the enhancement of distance education effectiveness.

The application of TAM to AI in distance education provides a valuable framework for understanding the factors influencing technology acceptance. From Figure 1, the authors argue that the use of AI for distance education is inseparable from the aspect of ease of access/operation of the technology used. Distance education will be challenging to implement if the platform used is not easy to access or use. This is because the ease of using technology will make both teachers and students comfortable using it (Saif et al., 2024). The ease of technology use will consequently impact the perceived benefits or usefulness by teachers and students (Saif et al., 2024). It is acknowledged that technology use that does not provide benefits will result in low technology usage. The use of AI to facilitate the continuity of distance education (e.g., ChatGPT, Bing, Perplexity, Gemini, Consensus, etc.) inherently provides its own benefits for teachers and students. The benefits provided by AI will drive its usage intensity and eventually AI will be used in actual practice within the scope of distance education.

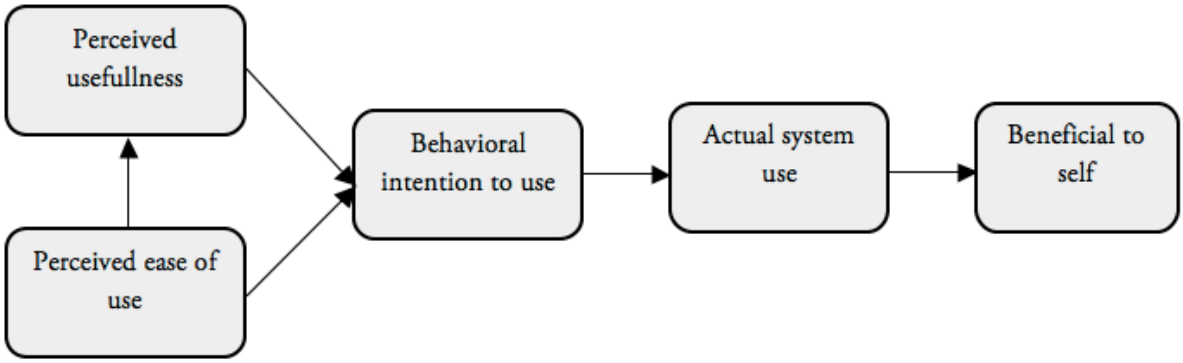

Figure 1. Adapted from technology acceptance model (Davis, 1989)

Self-Determination Theory

The Self-Determination Theory (SDT), pioneered by Ryan and Deci (2017), is a motivational theory in which individuals are viewed as proactive and create conditions that enable them to feel autonomous, competent, and connected to others. In the context of distance education, the authors argue that within SDT, the interaction between students and their virtual social contexts influences their motivation and development, such as understanding of materials, learning outcomes, online learning engagement, online discussion involvement, etc. Students may have different reasons for completing tasks or actively participating in class. In SDT, the reasons underlying this behavior are fundamental as they do not produce the same quality of outcomes (Guay, 2022). It is possible to distinguish various types of reasons (or motivations) that differ in terms of self-determination (Guay, 2022).

SDT is highly significant in the field of education, as students' natural inclination to learn may be the greatest resource that educators can leverage (Niemiec & Ryan, 2009). The Self-Determination Theory (SDT) is a motivational theory that emphasizes the importance of basic psychological needs in influencing individual motivation and engagement (Grasse et al., 2022; Peng et al., 2012; Tamborini et al., 2010). Within SDT, there is intrinsic motivation associated with the more productive forces behind any behavior (Deci & Ryan, 2000; Ryan & Deci, 2000) as intrinsic motivation triggers individuals' inner drive to engage in activities based on their personal interests (Deci & Ryan, 2008). In the context of distance education utilizing artificial intelligence (AI), the authors argue that SDT can provide profound insights into how student engagement can moderate the effectiveness of AI technology.

The Self-Determination Theory provides a robust framework for understanding how student engagement can moderate the effectiveness of AI in distance education. By fulfilling students' basic needs for autonomy, competence, and relatedness, AI can enhance intrinsic motivation and student engagement, ultimately improving learning outcomes (Li et al., 2024). Integrating the principles of SDT into the development and implementation of AI technology can help create a more effective and motivating learning environment.

Artificial Intelligence in Education

Education faces opportunities and challenges brought about by evolving artificial intelligence (AI) technology, which has the potential to fundamentally transform the structure, operations, and governance of educational institutions (Popenici & Kerr, 2017). Artificial intelligence refers to the capability of digital machines to perform tasks typically associated with intelligent beings, and its rapid growth is increasingly reshaping the ways people interact, communicate, live, learn, and work (Chiu et al., 2022; Xia et al., 2022). AI in education is widely used by students and educators today, involving various tools and applications (Chen et al., 2020b). AI in education supports learning by combining AI and various learning sciences, such as education, psychology, linguistics, and neuroscience, aiming to stimulate and advance the development of AI-based educational applications that exhibit flexibility, personalization, and effectiveness (Luckin & Holmes, 2016). AI technology provides opportunities for personalized learning experiences to meet individual learner needs (Ventura, 2017). The author argues that AI used in education encompasses not only virtual reality or augmented reality but also includes tools such as ChatGPT, Perplexity, Bing, and other chatbots. AI has three paradigms, in the first paradigm of AI, the focus is on AI directing cognitive learning, with learners serving as recipients of AI services. In the second paradigm, AI plays a supportive role, collaborating with learners who actively engage in the learning process. The third paradigm emphasizes AI's empowering role, where learners take charge of their learning while AI serves as a tool to enhance and facilitate their educational experience (Ouyang & Jiao, 2021). Here is the author's proposed design of AI in Education.

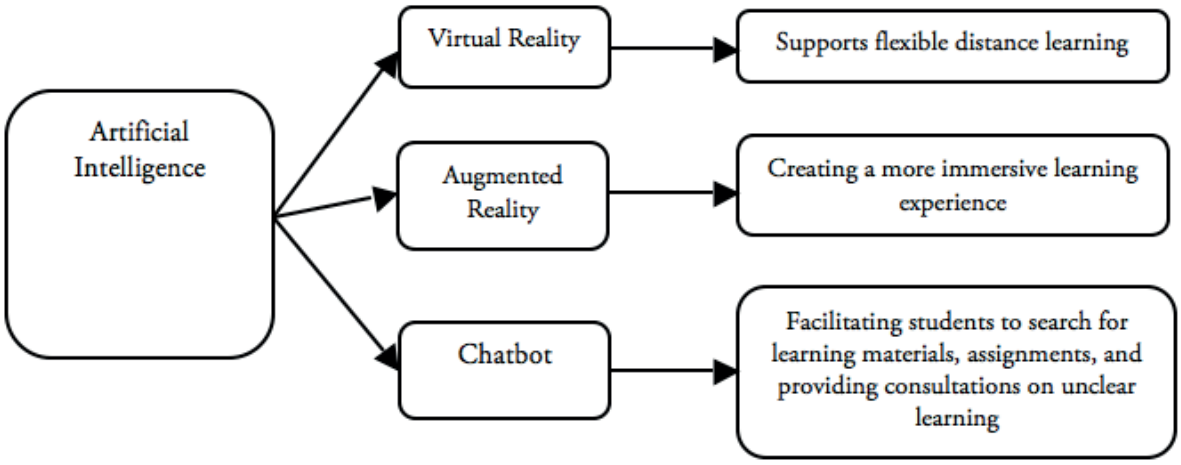

Figure 2. The model of artificial intelligence in education

Hypotheses Development

AI can be flexibly used anytime and anywhere depending on individual needs. It can be employed to address many challenges faced in online distance education and subsequently assist in optimizing the teaching and learning process (Dogan et al., 2023). When individuals encounter material they don't understand while studying and then use AI to find answers, this is a positive impact of AI usage. AI can present material and adjust learning content according to individual needs, provide immediate feedback, and create interactive learning experiences through chatbots, simulations, and educational games. The utilization of Artificial Intelligence (AI) in distance education will yield better educational outcomes (Chen et al., 2020a), measured by student engagement, speed of understanding, and overall academic performance compared to traditional online teaching methods without AI integration. AI in education has taken the form of adaptive

learning systems, intelligent tutoring systems, and other systems that enhance the quality of administration, instruction, and learning processes (Sharma et al., 2019). Moreover, AI has enabled the development and use of smart learning systems and adaptive content tailored to the needs and learning abilities of each student, such as smart virtual reality and the same use in teaching and learning simulations, which have been shown to have a positive impact on learning (Chen et al., 2020a; Pokrivcakova, 2019).

H1: Artificial Intelligence (AI) enhances the effectiveness of distance education

Student engagement has been considered key to student success (Garn et al., 2017). Engagement is grounded in the constructivist perspective, which posits that learning is shaped by an individual's active involvement in purposeful educational activities (Coates, 2005). Student engagement has been shown to be crucial for various positive learning outcomes, including academic achievement, self-esteem, general and cognitive abilities, psychosocial development, as well as students' well-being and satisfaction with the college experience (Lam et al., 2012; Li & Lerner, 2011; Zhoc et al., 2023). Student engagement in online classes is vital because it greatly impacts learning outcomes and overall effectiveness (Lasekan et al., 2024). Student engagement has been shown to be related to success in both online learning (Cerezo et al., 2016). Student engagement can enhance active participation in online discussions and activities, thereby promoting deeper understanding and retention of course material, leading to improved academic performance. Additionally, frequent interaction with instructors and peers fosters a supportive learning environment, resulting in increased satisfaction and motivation among students. Furthermore, student engagement encourages students to take responsibility for their learning process, which can reduce feelings of isolation often associated with distance education and decrease levels of active disengagement in class. Overall, student engagement plays a crucial role in maximizing the benefits of distance education by facilitating interaction, collaboration, and self-directed learning. Thus, the presence of student engagement in online classes will enhance the effectiveness of distance education.

H2: Student engagement enhances the effectiveness of distance education

The effectiveness of Artificial Intelligence in enhancing distance education is based on the synergistic interaction between active student engagement and AI's ability to personalize and enrich the learning experience. High student engagement enhances their responsiveness to AI interventions, such as instant feedback and customized materials, thereby improving understanding and retention of information. AI creates an interactive and engaging learning environment through features like chatbots, simulations, and gamification (Chen et al., 2020a), which in turn motivates students to participate more actively. When students are actively engaged, they are more likely to consistently follow and utilize the tools and resources provided by AI, ultimately reinforcing the effectiveness of distance education. In short, high student engagement and AI technology mutually support and enhance learning outcomes, creating a positive cycle that strengthens the overall impact of AI in distance education.

H3: Student engagement strengthens the impact of using Artificial Intelligence (AI) in enhancing the effectiveness of distance education

METHOD

Participants

The participants were students from undergraduate, master, and doctor programs from various universities in Indonesia, with a total of 281 respondents (male = 127 and female = 154) (see Table 1). The participant criteria were students who used AI and have undergone distance education (online) for at least one semester, so students who had never used AI and undergone online education were excluded from the data. Thus, out of the 302 respondents collected, 21 respondents were excluded because they did not meet the criteria, leaving a sample of 281 respondents. Respondent recruitment was done by distributing a Google Form to students via WhatsApp, Instagram, and Email to expand the respondent coverage. Participants were given one month to complete the Google form. Overall, the respondents were predominantly undergraduate students, totaling 186 individuals, and were mostly in the age range of 21-25 years, with 143 individuals (see Table 1).

Table 1. Demographics of respondents

		Frequency	%
Gender	Male	127	45.2%
	Female	154	54.8%
	Total	281	100%
Age	< 20	98	34.9%
	21 – 25	143	50.9%
	26 – 30	34	12.1%
	> 30	6	2.1%
	Total	281	100%
Education	Undergraduate	186	66.2%
	Master	88	31.3%
	Doctor	7	2.5%
	Total	281	100%
Province	North Sumatera	85	30.2%
	West Sumatera	7	2.5%
	Central Java	8	2.8%
	West Java	22	7.8%
	Jakarta	29	10.4%
	West Kalimantan	3	1.1%
	East Java	28	10.0%
	Riau	11	3.9%
	Yogyakarta	84	29.8%
	South Sumatera	4	1.4%
	Total	281	100%

Data Analysis

The statistical software employed for data analysis in the present study is the widely used statistical package for social sciences, in conjunction with Smart Partial Least Squares (SmartPLS) version 4. The first test carried out is factor loading with a value that must be above 0.50 (Templeton et al., 2002). Bootstrapping procedures are run to obtain significance (Hair et al., 2019). The alpha level for statistical significance is set at 0.05 (5%) and 0.10 (10%). The next step in the outer model is to differentiate validity. Discriminant validity is evaluated using three standard metrics: Fornell-Larcker, cross-loading, and Heterotrait-Monotrait ratio (HTMT) (Fornell & Larcker, 1981; Henseler et al., 2015). The diagonal value of constructs that increase should have a square root larger than the corresponding association coefficient. This sufficiently indicates that the two constructs are different or distinguishable (Fornell & Larcker, 1981). The HTMT statistic should be below 1 for all possible combinations of constructions (Henseler et al., 2015). The next step is related to the collinearity of the data. The collinearity can be assessed by examining the variance inflation factor (VIF) value. Based on existing research, it is recommended that VIF values should ideally be less than three or below five (Henseler et al., 2015).

Instrument

This study utilized instruments modified from previous research, and specifically, instruments for AI usage, distance education, and student engagement. The answers on the research instrument score use a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The AI instrument adapted from Al Algaithi et al. (2024), the distance education instrument adopted from Ozkaya et al. (2021), and finally the student engagement instrument adopted from Gunuc and Kuzu (2015) (see appendix 1). All instruments used met the criteria for validity and reliability with values above 0.70 and 0.60.

FINDINGS

Table 2. Fornell-larcker criterion

Variable	AI	DE	SE
AI	0.609		
DE	0.592	0.698	
SE	0.539	0.690	0.717

Note: AI: Artificial intelligence, DE: Distance education, SE: Student engagement

Discriminant validity analysis on the model indicates no discriminative issues. The first indicator of discriminant validity criteria, Fornell-Larcker (Fornell & Larcker, 1981), does not show any issues and demonstrates that all factors are significant (see Table 2). We can see this by ensuring that the value of each construct is greater than the correlation between constructs (e.g. 0.698 > 0.592).

Table 3. Heterotrait-monotrait ratio (HTMT)

	AI	DE	SE	SE × AI
AI	1			
DE	0.637	1		
SE	0.825	0.696	1	
SE × AI	0.330	0.429	0.323	1

Note: AI: Artificial intelligence, DE: Distance education, SE: Student engagement

The final discriminant indicator, HTMT, also does not show any discriminant validity problems because all combined construct values are below 1 – see Table 3 (Henseler et al., 2015).

Table 4. Hypothesis testing

Hypothesis	Paths	Std. Dev.	T statistics	P values	Decision
H1	AI " DE	0.094	1.731	0.084**	*Supported*
H2	SE " DE	0.095	5.382	0.000*	*Supported*
H3	SE × AI " DE	0.044	2.601	0.009*	*Supported*

Note: AI: Artificial intelligence, DE: Distance education, SE: Student engagement

* significant at the level of 5%

** significant at the level of 10%

Table 4 presents the results of the hypothesis analysis. The findings of the hypothesis for this study indicate that *H1* (t= 1.731, p < 0.10), *H2* (t = 5.382, p < 0.05), dan *H3* (t = 2.601, p < 0.05) was supported. We can see that the significance value of AI on Distance education is 0.084, then the inclusion of student engagement makes the significance value close to 0, which is 0.009. This indicates that the presence of student engagement further enhancing the relationship between AI and distance education.

Table 5. R-square

	R-square	R-square adjusted
DE	0.532	0.527

Note: DE: Distance education

Table 5 presents the results of *R-square*. *R-square* value or commonly known as the coefficient of determination, it is the proportion of the variance in the dependent variable explained by the independent variables. The analysis of this research model found an *R-square* = 0.532 (53.2%), indicating a moderate influence (Hair et al., 2022), while the remaining 46.8% is explained by other variables not examined in this study.

Table 6. Multicollinearity test

Variable	t	P values	VIF
AI " DE	1.731	0.084	2.101
SE " DE	5.382	0.000	2.094
SE × AI " DE	2.601	0.009	1.129

Note: AI: Artificial intelligence, DE: Distance education, SE: Student engagement

Table 6 presents the collinearity statistics (VIF) in the inner model. The table shows that overall VIF values in the inner model are below 3, indicating no significant multicollinearity (Henseler et al., 2015). Therefore, the test results are considered reliable or trustworthy.

DISCUSSION

The findings of this study indicate that artificial intelligence is significantly positively related to enhancing the effectiveness of distance education. The hypothesis that artificial intelligence (AI) enhances the effectiveness of distance education has been supported. Students who utilize and use AI can make the process of distance education effective (Dogan et al., 2023). The use of AI can enhance the productivity and performance of students in the classroom. AI such as ChatGPT, Perplexity, Bing, Consensus, Gemini, etc., can be beneficial for students when they do not understand the material being presented. Students who do not understand the lesson material, then they use AI to find out about the material and study it until they understand it. It is common for there to be lesson material that is difficult to understand in distance education. However, the presence of AI makes it easier for students to access information about the lesson material they are studying (Maphoto et al., 2024). Thus, the presence of AI will serve as a support system for students undergoing distance education. Based on the Technology Acceptance Model (TAM), when students perceive that AI is easy to use and beneficial, they are more likely to accept and use the technology, which in turn enhances the effectiveness of distance education.

AI-powered virtual tutors and chatbots provide instant feedback and assistance to students. These systems can answer questions, explain complex concepts, and provide additional resources, mimicking the benefits of face-to-face tutoring (Hwang et al., 2020). This immediate support helps students quickly overcome obstacles related to difficulties in understanding the subject matter. The automated system can handle multiple-choice questions, essays, and even complex problem-solving tasks with increased accuracy (Seo et al., 2021). AI ensures that all students, regardless of their physical or language challenges, can access and engage with educational materials effectively. By utilising these capabilities, AI can create a more effective, inclusive, and engaging online learning environment.

Next, the findings of this study indicate that student engagement is significantly positively related to enhancing the effectiveness of distance education. The hypothesis that student engagement enhances the effectiveness of distance education has been supported. The self-determination theory views individuals as proactive and creating conditions that enable them to feel autonomous, competent, and connected to others, thus leading a student to actively engage in the learning process. The findings of this research are relevant to Cerezo et al. (2016), who stated that student engagement has been proven to be related to success in online learning. Success in online learning serves as a form of the effectiveness of distance education. This indicates that student engagement plays a crucial role in determining the effectiveness of distance education. Student engagement plays a crucial role in determining the effectiveness of distance education. When students are

actively engaged in the learning process, they tend to be more motivated, focused, and participate in learning activities, thereby enhancing learning outcomes (Fredricks et al., 2004; Vermeulen & Volman, 2024). High engagement increases learning motivation because students feel more interested and connected to the course, learning materials, and teaching methods (Dennen et al., 2007; Kehrwald, 2008; Robinson & Hullinger, 2008). This encourages them to access materials more frequently, complete assignments, and participate in discussions, helping them overcome challenges of distance learning such as boredom or lack of social interaction (Dixson, 2015). Additionally, active engagement with course materials reinforces understanding of concepts because students are more likely to ask questions, discuss with classmates, and seek additional sources, all of which contribute to better knowledge retention (Trowler, 2010).

Social interaction also increases with student engagement, where students participate in online discussions, group work, and collaborative projects. These interactions build a supportive learning community, making students feel more connected and more likely to remain committed to the course and support each other in the learning process (Sharma et al., 2023). Additionally, engaged students are usually better at managing their time, setting priorities, and completing tasks on time, developing essential time management skills in distance education that require independence and high discipline (Trammell & LaForge, 2017). Student engagement also enhances their satisfaction and well-being. Students who feel engaged with their courses tend to be more satisfied with their learning experiences, contributing to better emotional and mental well-being, which are important factors for long-term learning (Zhoc et al., 2020). This satisfaction fosters a positive attitude toward learning and motivates students to pursue their studies. Additionally, high engagement enables more effective and constructive feedback from instructors. Engaged students are more likely to give and receive feedback in a constructive manner, helping them improve academic performance and better understand the material.

Furthermore, student engagement fosters active learning where students are not only passive recipients of information but also actively participate in the learning process (Boulton et al., 2019). This active learning involves activities such as discussions, debates, simulations, and practical projects that help students develop critical thinking and problem-solving skills. Overall, student engagement is a key factor influencing the success and effectiveness of distance education (Lasekan et al., 2024; Vermeulen & Volman, 2024). By enhancing student engagement, educational institutions can ensure that students not only achieve better academic outcomes but also have more satisfying and meaningful learning experiences, thereby enhancing the effectiveness of distance education.

Finally, the findings of this research indicate that student engagement strengthens significantly with the impact of AI in increasing the effectiveness of distance education. The hypothesis that student engagement strengthens the impact of using Artificial Intelligence (AI) in enhancing the effectiveness of distance education has been supported. Student engagement plays a crucial role in positively moderating the relationship between artificial intelligence (AI) and the effectiveness of distance education. When students are actively engaged, AI can maximize its potential to enhance learning experiences and outcomes (Seo et al., 2021). Firstly, student engagement ensures that the personalized learning offered by AI is fully optimized. AI analyzes student interaction data to tailor the material to individual needs, and engaged students are more likely to utilize personalized materials, ask questions, and seek additional resources suggested by the AI system. High engagement ensures that this personalization positively impacts understanding and retention of material (Zepke, 2021). High engagement strengthens the positive effects of interactivity facilitated by AI, making learning more engaging and enjoyable (Gupta, 2023). Furthermore, high student engagement leads to students appreciating the learning process and motivating themselves to actively participate during learning (Schnitzler et al., 2021). When encountering less understood topics, students can interact with AI such as chatbots; then, as they grasp the learning material, they can contribute during the learning process. Based on the self-determination theory (SDT), student engagement influenced by the fulfillment of autonomy, competence, and relatedness needs reinforces the positive impact of AI in enhancing the effectiveness of distance education. Thus, student engagement ensures that AI can reach its potential to improve learning, provide better support, and make distance education more effective and satisfying.

CONCLUSION

Based on the hypothesis testing results and discussion of the research findings, it is concluded that AI can enhance the effectiveness of distance education, student engagement can improve the effectiveness of distance education, and student engagement can enhance the impact of AI in promoting the effectiveness of distance education. Additionally, these findings affirm that psychological, cognitive, and technological factors play a significant role in enhancing the effectiveness of distance education. This demonstrates that the combination of cognitive psychology with artificial intelligence will have a positive impact on the effectiveness of distance education.

This study is not without limitations. Firstly, data collection through surveys inherently comes with its own shortcomings. Secondly, the study did not utilize control variables such as gender or age, which could potentially have an impact on the research outcomes. Thirdly, the authors acknowledge the limited number of respondents, which cannot be considered representative of the entire student population in Indonesia. Fourthly, the diversity of educational contexts, including variations in subjects and educational levels, also poses challenges in generalizing the findings. Lastly, measuring student engagement is subjective and may rely on self-reported data, which could introduce potential bias. Caution is advised in interpreting the research results due to the study's limitations.

Based on the limitations mentioned above, the authors suggest that future researchers should consider providing broader developments, such as adding new research variables (such as control and mediation variables, i.e., learning motivation, learning interest, etc.) and also consider adding additional data analysis techniques such as robustness tests and sensitivity tests, as well as including research subjects from other countries (such as East Asia). Subsequent studies may employ experimental designs or case studies and may also consider using qualitative methods (open questions) to expand the validity of the research findings. Furthermore, future research is expected to explore different theories such as the Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2) or other relevant theories to validate the findings and broaden knowledge expansion and generalization. Additionally, future research may consider incorporating the perceptions of teachers/professors, as this would provide valuable insights into how teachers/professors conduct activities and adopt distance education teaching strategies. Therefore, further research is needed to determine which strategies are most effective in improving the effectiveness of distance education. The findings of this study are expected to be developed and beneficial in the future.

The theoretical implications of this research include the emergence of a new perspective that the combination of cognitive psychology with AI can enhance the effectiveness of distance education and possibly its quality as well. The research findings demonstrate the alignment and validity of the theories used by the researchers. This study expands the Technology Acceptance Model (TAM) in the aspect of distance education. Furthermore, the practical implications of this research lie in the fact that the use of AI for the effectiveness of distance education is influenced by the cognitive psychology of students. Therefore, it is important to ensure that students are actively engaged in the learning process and provide space for them to think critically and express their opinions without any pressure. Based on these findings, educators and policymakers are encouraged to consider integrating AI with cognitive psychology aspects to support students in enhancing the effectiveness of distance education.

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APPENDIX 1

Artificial Intelligence (AI)

1. I find AI easy to use
2. Learning how to use AI is easy for me
3. It is easy to become skillful at using AI in learning
4. The interaction with AI in learning is clear and understandable
5. Using AI in learning would increase the students' learning performance
6. Using AI in learning would increase academic productivity
7. Using AI would make learning easier
8. Using AI in learning is useful for context-based interactions as in real-life
9. AI enable students to learn more quickly in learning
10. AI make it easier to innovate in online learning
11. The advantages of AI in online learning outweigh the disadvantages
12. I believe that using AI will increase the quality of online learning
13. I am completely satisfied in using AI for learning
14. Using AI in online learning is a good idea
15. I am positive towards using AI in learning

Distance Education

1. Distance learning is academically more interesting than face-to-face education
2. The quality of education increases with distance education
3. Programs should be opened in different fields in distance education
4. Distance education is essential to meet the need for trained manpower
5. I believe that in the future, distance education will be more preferred than traditional education
6. Compared to face-to-face education, the cultural diversity of students in distance education is greater
7. My experiences in distance education have positively changed my perspective on distance education
8. In the distance education environment, students get the opportunity to think analytically
9. Distance education students socialize more in electronic environment
10. Compared to face-to-face education, distance education provides students with flexibility in terms of resource use
11. Communication tools used in distance education are technologically sufficient
12. Communication tools used in distance education are educationally sufficient.
13. Distance education programs are well-planned in my institution.
14. The learning management system used in the presentation and execution of the courses is sufficient
15. Compared to face-to-face education, distance education provides students with flexibility in terms of time usage
16. Universities give students access to electronic material to support distance education
17. Universities prepare electronic materials such as e-books and e-journals to support distance education for students
18. Students are provided with sufficient technical support to solve technical problems they encounter in distance education

STUDENT ENGAGEMENT

Class Engagement

Cognitive Engagement

1. I motivate myself to learn
2. I determine my own learning goals
3. I try to do my best during classes
4. Besides doing my lessons, I further study for my lessons
5. What I learn in class is important for me
6. I discuss what I have learned in class with my friends out of class
7. I attend classes by geting prepared in advance
8. I try to do my homework in the best way
9. I enjoy intellectual difficulties I encounter while learning
10. I spend enough time and make enough effort to learn

Emotional Engagement

11. My teachers are always near me when I need them
12. I give importance to studying together with my classmates (in a group)
13. My classmates respect my thoughts/views
14. I think my courses are beneficial for me
15. I respect my classmates
16. I respect my teachers
17. I am interested in my courses
18. I feel myself as a part/member of a student group
19. I feel anxious when I don't attend classes

Behavioral Engagement

20. I am an active student in class
21. My teachers behave fairly to all my friends
22. I attend classes willingly
23. I carefully listen to my teacher in class
24. My teachers interact/communicate with me
25. I follow the rules in class
26. I do my homework/tasks in time
27. I carefully listen to other students in class
28. I try to do my best regarding my responsibilities in group work
29. I share information with my classmates

EFFECTIVENESS OF FLIPPED VIDEO-BASED FEEDBACK IN ONLINE CLASSES AND TRADITIONAL TEACHING ON THE QUALITY OF WRITING COMPONENTS AND STUDENTS' WRITING SKILLS

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ABSTRACT

The aim of this research was to examine the effectiveness of video feedback in improving the quality of writing components and writing skills using flipped in online class and traditional teaching. The method used in this research was a quasi-experiment by dividing participants into two experimental groups, namely the group that received video feedback intervention with reverse instructions and group that received video feedback intervention with traditional writing instructions. The participants involved in this research were 300 high school students with a gender composition of 150 women and men each. The writing components measured were content, writing organization, vocabulary, language and sentence use. Data analysis used nonparametric tests and Mann- Whitney and Wilcoxon Signed Rank Tests. The results of the study showed that the quality scores of all writing components and writing ability who received reverse and traditional instruction intervention in the posttest phase showed a significant increase compared to the pretest phase. However, video-based feedback with flipped teaching online class had a more significant impact on the quality of the writing component and students' writing ability compared with traditional teaching. The component that shows the most significant improvement is the organizational component and is followed by the language component, vocabulary. The component that shows the smallest improvement is the mechanical component of the sentence. The mechanical component of the sentence is least affected because this component has not been able to attract students' attention optimally. These findings indicate that video feedback intervention is able to effectively improve the

quality of writing components and students' writing abilities. The implication of this research is that teachers can combine feedback with media to create innovative and effective learning processes in improving product quality and student abilities.

Keywords: Flipped teaching, online class, traditional teaching, video feedback, writing component quality, writing skills.

INTRODUCTION

The writing skills of students in Indonesia is still not optimal. The majority of students find it difficult to organize their ideas into written form with good organization. This problem arises at every level, starting from elementary, middle, even students at the higher education (Alobaid, 2020; Estaji & Safari, 2023) the study explored the learners' perceptions of LOA through a survey questionnaire. To collect data, 116 English learners at an intermediate level of proficiency participated in the study and responded to Barrat's BIS 11 learning style questionnaire (Journal of Clinical Psychology 51:768–774, 1995. Writing skills is a productive language skill, meaning that a good amount of information and other language skills are needed in order to become a reliable writer. The emergence of the problem of writing difficulties among students is caused by several factors, including students' limited schemata regarding the topic and type of text that will be produced, not much good technical knowledge of writing, starting from aspects of organization, content, language, sentences and mechanical aspects (Deti et al., 2023; Talebinamvar & Zarrabi, 2022) a quasi-experimental design was used. Consequently, from 25 sections in the first year of natural sciences, two sections were selected using lottery method. A coin was flipped to assign them to the control and the experimental groups. In the study, a control group of 49 and an experimental group of 50 participants participated. A questionnaire was administered to both groups before and after treatment to measure writing attitudes and writing achievement goal orientations. A one-way between groups Multivariate Analysis of Variance was calculated using Statistical Package for Social Sciences (SPSS. These limited abilities make it difficult for students to produce quality writing. This writing ability problem is also caused by the not yet optimal use of teaching methods or models in improving students' writing skills. The majority of teachers use very boring methods and are unable to properly improve the performance and quality of students' writing (Ma, 2023a; Price, 2020). Based on these problems, a teaching method is needed that is not only able to improve students' writing skills and the quality of their writing, but is also able to increase students' motivation in learning to write well. One of them is modifying existing teaching methods with digital media or digital-based teaching methods. This digital-based teaching method has been widely used in various fields of study, especially in improving students' ability to produce products, one of which is written products (Mohamadi Zenouzagh, 2018; Rogers & Graham, 2020).

Productive language skills are writing and speaking skills. Writing skills are productive language skills because this skill requires several other skills and produces a written product. This skill certainly requires basic abilities obtained from receptive reading and listening skills. The ability to write requires other abilities such as the ability to generate ideas, organize ideas, and convert ideas into writing (Roitsch et al., 2021; Wu et al., 2020). Based on the results of previous research, writing ability is the language skill that is most difficult for high school students to master (Khosravi et al., 2023; Luo et al., 2020). Writing teaching activities are a type of teaching that has many aspects in the academic domain. Writing skills are not only needed for students, but are also needed for higher education students who are required to publish their written work in international journals (Morales-Rando et al., 2022; Roald et al., 2021). Writing instruction is currently experiencing developments that are not only traditional, but also utilize various media and technology to encourage students' writing skills. Providing feedback is one of the trending teaching methods that can improve the quality and ability of students' writing. Providing feedback also looks quite promising in improving the quality of students' writing in several previous studies (Buhl-Wiggers et al., 2023; Lin, 2019). Teaching using technology to provide feedback opens up opportunities for teachers to design innovative strategies to overcome students' writing difficulties.

Currently, digital-based writing learning is more widely known by teachers and students. This development encourages teachers to be more creative in combining learning models with the technology they use so that

they are effective in enhancing students' writing skills (Fathi & Rahimi, 2022; Su Ping et al., 2020). The reverse model of teaching is widely used in learning inside and outside the classroom using cellphones. The use of flipped teaching in writing research is still not widely used. Several previous studies have proven that traditional multimedia-based classes show quite effective learning in improving students' writing skills (Li et al., 2022; Roehling, 2018)but some important issues still need in-depth exploration, including how to increase learners' autonomous learning motivation before the class, how to work with in-class discussion activities, and how to improve learner's concentration on discussions and lower their learning anxieties for high-level cognitive thinking. This study integrated theories of digital game-based learning (DGBL. However, this research is different from previous research. This study tried the effectiveness of video feedback by using flipped teaching instructions and video feedback with traditional teaching instructions. The research focuses on components of student writing and student writing abilities. Even though there has been quite a lot of language learning using various technologies, there is still little research using technology-based feedback in writing learning. Based on this explanation, the researcher formulated the problem formulation in this research, namely how the combination of video feedback with reverse teaching and traditional teaching affects students' writing components and abilities.

LITERATURE REVIEW

Teacher Feedback

One of the factors that most determines student success in improving the quality of student writing is feedback. Effective feedback can improve students' ability to express new ideas and ideas into writing. Through feedback, students can learn from shortcomings or mistakes, so they can improve their writing skills to be better (Yang & Chen, 2020; Zou & Xie, 2019). Several previous studies found that feedback has proven to be quite effective in improving students' writing abilities to more than 50% of students' initial abilities (Bai et al., 2020; Challob, 2021). Apart from that, this feedback can also improve students who have lower academic abilities compared to students who have high academic abilities. This feedback is also able to minimize the gap between students who have high achievements and students who have low achievements. This feedback has also been proven to be effective not only on language skills, but has also been proven to be effective in improving other skills (Afzali & Izadpanah, 2021; Buhl-Wiggers et al., 2023). Active participation in feedback activities greatly influences teacher confidence in increasing student productivity. Feedback has been proven to be effective in improving students' writing skills, but teachers are often unable to facilitate students to achieve writing learning goals because of the limitations of the feedback media (George & Vineall, 2022; Roehling, 2018). This gap between goals and achievements can be overcome by combining feedback with media or technology. Students often feel confused by the instructions given by the teacher regarding the feedback given. These alternative traditional and technology-based feedback techniques can be used in the formative and summative evaluation phases. The use of technology in the evaluation process really helps teachers in combining teaching techniques. Technology-based feedback on writing skills provides opportunities for teachers to encourage better component quality and student writing performance.

Video Feedback

Video based feedback rated better value than written or traditional feedback. Video feedback is feedback that uses screencast videos with several media including images, animation, illustrations and narration, not just verbal feedback to students. This video-based feedback gives students the opportunity to get emotional responses and reactions more clearly than relying solely on traditional feedback (Alobaid, 2020; Ma, 2023a). In the process, teachers can involve students interpersonally when providing verbal comments. In other research, video-based feedback using screencasts was used to provide feedback on their work. This device can save feedback comments and send them to the student's email. From the results of this research, the majority of students understand the input from the feedback more meaningfully than just input in the form of written comments (Choy & Cheung, 2022; Rogers & Graham, 2020). Students can clearly understand the phrases or sentences that need improvement through video feedback. This activity makes students more motivated to revise their writing, so that the quality of their writing gets better after getting video feedback.

Other research also proves that video comments for students learning to write a second language can make teachers and students more able to create meaningful learning processes through media that can increase student and teacher motivation (Alobaid, 2020; Deti et al., 2023). The results of this research show that video feedback is not only able to increase writing motivation but is also able to change students' negative opinions regarding writing skills in a second language. This factor is very important for second language learners who have the paradigm that writing skills in a second language are very difficult. Video-based feedback has very clear feedback advantages. This feedback is considered to be the feedback that best suits project-based learning in the classroom. Students are aware that working with visual media will really help in improving the quality of the projects they work on (Hand et al., 2021; Mohamadi Zenouzagh, 2018). However, this video-based feedback has the disadvantage that it requires quite a large device capacity. Other studies investigated feedback on multiple trials. This type of feedback is commonly used in formative evaluations which provide opportunities for students to improve their work through technology-based feedback. This technology-based feedback encourages students to find their own mistakes and correct them while learning new concepts provided by technology-based feedback (Wang et al., 2018; Zou & Xie, 2019). The main aspect that students get from technology-based feedback is that students can remember and carry out work with the same concept after the learning process has been completed.

Recent research investigating video-based feedback has proven effective in improving students' scientific argumentation skills. Students consider this video-based feedback superior to written or traditional feedback (Alobaid, 2020; Ma, 2023b). This video-based feedback is able to improve the quality of students' arguments by improving the components of the arguments they make. This feedback is considered to have excellent advantages in being applied to productive language learning. Other research also shows that there is a difference between oral language skill abilities that receive video-based feedback and traditional feedback (Fathi & Rahimi, 2022; Wu et al., 2020). Video-based feedback has a positive impact on the quality of the language skills used. They are able to improve the vocabulary, phrases and sentences they use when speaking. This is obtained from very clear video-based feedback. This video-based feedback is able to actively involve students to check their performance deficiencies and improve them based on clear input provided by the teacher.

Teaching Writing in the Flipped Classroom and the Traditional Classroom

Traditional writing teaching is teaching that uses a material approach with printed text or worksheets and focuses on the teacher. Traditional teaching is a teaching method whose general series of activities does not involve the writing process directly, only in the form of traditional instructions about writing (Estaji & Safari, 2023; Hadianto et al., 2022a). This traditional teaching requires a supportive learning environment where students must be in the same context as the material being studied. In the traditional approach, the teacher acts as a provider of material while the students act as recipients of information, so that students appear passive in participating in the learning process. These factors make students easily bored and the paradigm that writing skills emerge is very difficult to learn even though the teacher has used all his abilities in teaching. The majority of students in Indonesia still have problems with writing skills compared to other language skills because many teachers still use traditional teaching (Hadianto et al., 2022b; Mulyati & Hadianto, 2023). The weakness of traditional teaching is that the series of activities are still not optimal in increasing students' interest in learning. Traditional teaching is also considered unable to overcome students' difficulties in writing. Currently, teachers must be able to create more teaching approaches that are able to answer students' current needs. One of them is modifying traditional writing teaching to make it more interesting and innovative by combining it with various technologies (Alobaid, 2020; Choy & Cheung, 2022).

Flipped classroom teaching is an alternative teaching that can be used by teachers besides traditional teaching. The reverse teaching method focuses on transferring tasks into a certain context using other media that is able to highlight aspects of learning in certain media. The theory that supports flipped classroom teaching is that sociocultural conditions and environments must provide autonomy support and ignore external control (Herrero et al., 2019; Liu & Chung, 2021). This learning environment can increase learning motivation and opportunities for students to reflect on student abilities, receive support from friends and teachers, regulate themselves independently, and encourage students to make their own decisions. Previous research proves

that pedagogical tools are integrated in the learning process with new classes and flipped classes. The results showed that students' academic achievements, professional knowledge and abilities improved significantly (Challob, 2021; Wang et al., 2018). In addition, the effeciency of the flipped teaching is also proven in student achievement and self-efficacy. From this research, it was found that the flipped classroom was able to encourage students to be more productive and the teaching process was more interesting. Flipped classes are also able to make students more responsible for their activities during the learning process.

METHOD

This research uses a quasi-experimental design with purposive sampling technique. The statistical analysis used is the Mann-Whitney test and Wilcoxon Signed Rank to answer the research problem formulation.

Participants

Participants in this research were 300 high school students with a gender proportion of 150 students each, female and male. Participants were divided into two experimental groups, namely experimental group 1 which received video-based feedback intervention with flipped classroom writing online teaching and experimental group 2 which received video-based feedback intervention with traditional writing teaching. The age of the students in the research sample was in the range of 17-19 years. The focus of this research investigates the components of student writing which include content, idea organization, vocabulary, language, sentences and overall writing ability. The research was conducted for one year or two semesters at the high school level. The population in this study were high school students in the Bandung area who had learned to write various types of text. The sample was selected purposively who had learned to write so that teachers could control the influence of teaching on students' writing abilities. Apart from that, the purposive sampling technique was used because the researchers used digital instruments for one year in the writing learning process. Researchers investigated writing components and writing abilities with a standard of 0.05 to ensure that all students in the sample had homogeneous writing abilities in both experimental groups.

Instruments

Writing Assignments

Writing ability data was collected by giving writing assignments on several themes, namely health, natural disasters and government policy. Students are asked to determine the title of their own writing on this theme. The development of ideas or concepts in the pretest phase is left to the students. Themes are determined according to the focus of high school students' majors in science and social studies. In the pretest phase, students are only asked to pay attention to the assessment components which include content, idea organization, vocabulary, language, sentences and use of punctuation. After the pretest phase, intervention was carried out with two types of intervention, namely video-based feedback with flipped classroom writing teaching and video-based feedback with traditional writing teaching. Finally, a posttest was carried out by assigning students to write explanatory text with the same themes as those carried out in the pretest phase.

Writing Assessment Rubric

The writing assessment rubric used in this research is an analytical rubric using a 5-point assessment scale which includes content, idea organization, language, vocabulary and mechanical aspects. Assessment of content aspects is carried out on thesis development, substance and overall content coherence. Organizational aspects include coherence and cohesion of ideas, clarity of ideas, use of supporting ideas, idea organization, and idea development. Vocabulary aspects include word choice, use of word forms, and use of appropriate vocabulary. Aspects of language use include complex sentence construction, appropriate use of time, effective word order. Aspects of using punctuation include the use of spelling, punctuation, and capital and small letters, and creating paragraphs. The score composition used in each aspect is content component: 25, idea organization component: 25, language use component: 20, and vocabulary component; 15, and mechanical sentences component: 15. The total value used is 100.

Video-based Feedback Intervention Device

Video-based feedback using the Snagit application during the learning process. Snagit can record teachers giving feedback or instructions clearly, so students can get clear feedback. Snagit can also create documentation and show students what they have done. This program is considered the best program in providing feedback to students. Snagit is usually used by teachers to provide assessments, input and feedback for products produced by students.

Tablet Devices in Providing Feedback

Explaining concepts through visual media, teachers use the Art Creative Pen application and Touch tablets in the learning process. While the Snagi application records all activities, teachers use tablets to provide feedback to students. The use of brushes, highlighters and colored pencils makes it easy for teachers to provide feedback and instructions in providing feedback to students. This process is considered the most effective process in improving the quality of student writing.

Video-based Writing Intervention with Flipped Teaching and Traditional Writing Teaching

Overall teaching is carried out over 32 sessions over two semesters. The first semester of teaching is carried out directly, the following semester is carried out using recordings of previous meetings and reinforced. Grammar teaching is carried out by uploading it to a learning management system or LMS that students can access which is packaged using the flipped classroom method. Teaching materials can be studied repeatedly by students through the LMS and can be accessed at any time. Traditional writing teaching is done conventionally. The teacher delivers the material directly in class. Writing materials include organization, grammar, language use, sentences, and punctuation. Traditional teaching can only be done in class and there is no opportunity for students to repeat or access it again outside of class.

Data Collection and Analysis

The experimental group that received video-based feedback intervention with a flipped classroom received 35% of the class content with composition in the first three sessions. Students were given the opportunity to access, interpret, and repeat the flipped instruction and digital feedback. This video-based feedback was uploaded into a learning management system that was accessible to all students in this experimental group. During this intervention process, the teacher assigns students to write on several predetermined topics. This writing assignment is carried out during class and can be taken home. Collection is carried out via email. Next, the teacher provides video-based feedback based on each student's assignment and gives the feedback back to the students via email.

Students in the second experimental group received video-based feedback intervention with traditional classroom teaching in the writing learning process. The content in traditional teaching is the same as in flipped classroom teaching, but there are some differences in the technical implementation. Traditional teaching is carried out using flipped classes on aspects of paragraph structure, the creation process, paragraph comparisons and differences. However, teaching on aspects of grammar, sentences, sentence parallels, subjects and predicates, adjective clauses, nouns, adverb clauses is taught directly to students and combined with carrying out assignments at home. In the next session, the teacher provides discussion and provides reinforcement until all students understand their mistakes and can correct them.

Data analysis was carried out using SPSS software version 22. Normality tests were carried out using the Mann-Whitney test and Wilcoxon Signed Rank. Comparison of differences between two independent experimental groups was analyzed using the Mann-Whitney U Test. Analysis of differences between two experimental groups with the dependent variable (pretest and posttest phases in flipped teaching and pretest and posttest phases in traditional teaching.

Validity and Reliabity

The reliability test was carried out by asking several assessors to assess students' writing at two stages. Reliability testing can be seen in whether the assessor's procedures can show the same results in repeated experiments. Researchers asked teachers to provide assessments on aspects of content, organization, use of

words, sentences, grammar and mechanical aspects using a rubric (Joseph Jeyaraj et al., 2022; Khoynaroud et al., 2020). Before the assessment is carried out, a practice session is carried out so that the assessors gain a clear and comprehensive understanding of all elements of the rubric assessment. Next, 45 students' writing in the pretest and posttest phases was assessed by the assessors and asked the assessors to report the results within a period of one and a half months. In order to avoid subjective aspects, the researcher did not indicate which student's writing belonged to the experimental group. Next, the reliability test in the pretest and posttest phases was calculated using the t test, the results of which are explained in tables 1 and 2. From the explanation in tables 1 and 2, the average value of each assessor was obtained with a significance level of 0.680 and 0.731 in the pretest and posttest phases. . This value is greater than the p value of 0.05. From these values it can be concluded that there are no significant differences between raters. This shows that the rubric assessment is reliable and can be used for research.

Table 1. Pre-test reliability test results

	F	M	SD	T	sig
Appraiser 1	45	40.2	4.7	−0.321	0.680
Appraiser 2	45	38.5	4.5		

Table 2. Post-test reliability test results

	F	M	SD	T	sig
Appraiser 1	45	44.3	3.4	−0.542	0.731
Appraiser 2	45	46.6	3.7		

FINDINGS

The Effect of Video-based Feedback with Flipped Teaching in Online Class on Component Quality and Students' Writing Ability

Based on table 3, each writing component showed better posttest scores in the pretest phase of the experimental group that received video-based feedback intervention. From these data it can be determined that this video-based feedback is able to enhance the quality of students' writing components. Another finding is that the average score for each writing component varies, which means that video-based feedback has a different influence on each student's writing component. The Wilcoxon Signed Rank test was carried out to determine the differences in the impact of the intervention on each component of student writing. Based on the results of the Wilcoxon Signed Rank Test, the sig. the difference between the pretest and posttest phases shows 0.000 which has a value lower than 0.05. From these data it can be concluded that the average scores in the two phases show significant differences in each component of student writing. So, this video-based feedback is able to have a significant impact on all components of student writing in flipped teaching. The organizational component had the most significant effect from the intervention compared to other components that had a value (m = 26.31, Z = 4.24). The next component is followed by the content component with value (m = 25.21, Z = 5.325), language use component (m = 24.53, Z = 5.341), vocabulary (m = 15.71, Z = 4.771).

The component that received the least influence from the intervention was the sentence mechanism component with value (m = 9.56, Z = 4.523). Students' writing ability in the pretest phase showed a value (m = 45.64, SD = 7.92) and there was an increase in students' writing ability in the posttest phase with a value (m = 96.31, SD = 4.75) in the experimental group who received video-based feedback intervention with flipped teaching . From the data presented, it can be said that video-based feedback with reverse teaching is able to improve students' writing skills. Next, to investigate whether there are statistically significant differences in each phase, the Wilcoxon Signed Rank Test is carried out to find out. Research findings show that the sig value in the pretest and posttest phases is 0.000. This value is lower than 0.05 with $P < 0.05$, and Z = 4.376. This data shows that the differences in the two pretest and posttest phases show significant differences. So, video-based feedback with flipped teaching can improve students' writing abilities and the quality of their writing components.

Table 3. Quality of student writing components with flipped teaching

Writing component	N	Mean	SD	Rank
Content Component Posttest	150	25.21	1.42	2
Pretest Content components	150	11.70	3.24	
Organizational Component Posttest	150	26.31	1.21	1
Organizational Component Pretest	150	10.88	1.92	
Vocabulary Component Posttest	150	15.71	2.30	4
Vocabulary Component Pretest	150	7.87	1.71	
Posttest language use	150	24.53	2.24	3
Pretest language use	150	11.12	2.11	
Sentence Mechanical Component Posttest	150	9.56	.74	5
Pretest Mechanical components of sentences	150	7.02	.93	

The Effect of Video-based Feedback with Traditional Teaching on Students' Writing Components and Abilities

Based on the data presented in table 4, each component of students' writing who received video-based feedback intervention with traditional teaching showed an improvement in the posttest phase. These data show that the intervention was able to improve the quality of students' writing components. The average score for the quality of students' writing components in the posttest phase also varied and differed. This shows that video-based feedback interventions with traditional classes have different influences on each component of students' writing. The Wilcoxon Signed Rank Test was carried out to investigate the differences in each pretest and posttest phase whether there were significant differences or not. From the test results it was found that the sig value of the difference in both pretest and posttest phases showed a value lower than 0.05. These data show that the average scores of the two pretest and posttest phases for the quality of students' writing components have significant differences. So, video-based feedback with traditional teaching can have a significant influence on the quality of students' writing components. The most superior components as a result of the intervention were the content component with values (m = 16.31, z = 3.347, P = .001) and the organizational component with values (m = 14.31, z = 4.345, P = .001). Next, followed by the language use component with a value (m = 15.54, z = 3.435, P = .031), vocabulary with a value (m = 11.45, z = 3.572, P = .000) and finally the sentence mechanics component with a value (m = 8.13, SD = 3.241, P = 0.001). Based on the research results, the quality of students' writing components also showed an overall improvement. In the pretest phase it showed a value (m = 50.22, SD = 8.45) and experienced an increase in the posttest phase (m = 63.45, SD = 8.31). These findings indicate that video-based feedback intervention with traditional teaching is able to improve the quality of students' writing components. Next, a significance test of differences was carried out in the pretest and posttest phases of students' writing abilities using the Wilcoxon Signed-Rank test. From the test results, a sig value was found with a difference level between the two phases of 0.000, which indicates a value lower than 0.05 with a value of (z = 4.561). This value shows that there is a significant difference in writing ability scores in the pretest and posttest phases. So, video-based feedback with traditional teaching can improve the quality of the writing component and students' writing abilities.

Table 4. Quality of students' writing components with traditional teaching

Writing component	N	Mean	SD	Rank
Content Component Posttest	150	16.31	3.82	1
Content components Pretest	150	12.31	3.42	
Organizational Component Posttest	150	15.31	4.20	1
Organizational Component Pretest	150	12.71	2.89	
Vocabulary Component Posttest	150	11.45	2.78	3
Vocabulary Component Pretest	150	7.18	2.30	
Posttest language use	150	15.72	4.21	2
Pretest language use	150	13.31	3.31	
Sentence Mechanical Component Posttest	150	8.13	.93	4
Pretest Mechanical components of sentences	150	5.04	.45	

Table 5. Results of the Mann–Whitney U Test on the average pre-test score for the quality of the writing component in Both Groups

Writing component	Content Components	Organizational Components	Vocabulary Components	Components of Language Use	Sentence Mechanical Components
Mann-Whitney U	254	246	230	228	218
Wilcoxon W	570	568	552	548	546
Z	–.775	–.934	–1.241	–1.320	–1.271
Asymp. Sig. (2-tailed)	.452	.364	.272	.237	.250

Table 6. Post-test average score for the quality of writing components with traditional and flipped teaching

Teaching	Content Components	Organizational Components	Vocabulary Components	Components of Language Use	Sentence Mechanical Components
Flipped Teaching	25.21	25.70	15.57	24.64	9.82
Traditional Teaching	16.46	16.34	11.52	15.70	8.10

Differences in the Influence of Video-based Feedback with Flipped in Online Class and Traditional Teaching on the Quality of Writing Components and Students' Writing Abilities

Based on the presentation of Asymp sig data in table 5, the quality value of each component of student writing shows a value greater than 0.05. From these values it can be concluded that there were no significant differences found in the pretest phase between the groups that received reverse teaching intervention and traditional teaching in the quality aspects of the writing components. From the results of this research, it is not necessary to control the influence of the pretest and calculate the pre-difference between the two phases. Analysis can be carried out on posttest scores directly. Based on the research results presented in table 6, the average score on all writing component qualities in the first experimental group who received reverse teaching intervention was superior to students in the second experimental group or who received traditional teaching. From these findings, it can be said that video-based feedback with reverse teaching is able to improve the quality of the writing component statistically better than video-based feedback with traditional teaching. Next, an investigation was carried out using the Mann-Whitney U test to determine whether

there were significant differences in each component's quality of students' writing. From the test results, the significance value of all writing components shows a value lower than 0.05, which means the difference in the average score of all components in the posttest phase is very significant. The value of each component of student writing is as follows, the value of the content component (P = 0.000, Z = 7.014), organization component (p = 0.000, Z = 6.887), vocabulary component (P = .000, Z = 6.745), language use component (P = .000, Z = 6.846), and sentence mechanics components (P = .000, Z = 5.856). Video-based feedback with flipped teaching is more effective than traditional teaching, which is also confirmed by research findings on students' writing abilities. From the research results, writing ability with reverse teaching in the pretest phase received a score of 61.45 and in the posttest phase 96.30. These data show that video-based feedback with flipped teaching is superior in having an impact on the quality of writing components and students' writing abilities compared to traditional teaching.

DISCUSSIONS AND CONCLUSION

Overall, the research findings show that the average quality score for all components shows an increase in the posttest phase. These findings are in accordance with several previous studies which showed that students' reading and writing abilities showed improvement after receiving video-based teaching interventions. An increase in students' abilities was seen in understanding reading problems and writing back findings in the reading. Apart from that, this video-based feedback can encourage students to be more interactive in following the learning process. Video-based media in language teaching can increase students' interest and motivation in learning. Apart from that, this media is also able to facilitate students to achieve learning goals effectively and attract students' attention to remain focused during the learning process. Video-based feedback has a positive impact on the quality of students' writing components, including content, organization, vocabulary, language and sentence components (Joseph Jeyaraj et al., 2022; Li et al., 2022). The component that shows the best improvement is the organizational component, followed by the content, language, vocabulary and sentence components. From these findings, it can be concluded that video-based teaching is more effective and efficient in improving the quality of organizational components. The writing component that attracts less attention from students is the mechanical component of the sentence which includes the use of letters, punctuation and spelling, so this component has the least impact from video-based feedback (Khoynaroud et al., 2020; Turan & Akdag-Cimen, 2020). Student editing in the flipped learning process allows students to improve students' self-monitoring abilities. This causes the ability to organize ideas to improve significantly in reverse teaching. This is confirmed in theory that the self-assessment carried out by students in evaluating the learning process is able to increase student responsibility in carrying out assignments, so that students can anticipate errors in the content and organization of students' writing (Khosravi et al., 2023; Mohamadi Zenouzagh, 2018). These findings also strengthen the fact about the effectiveness of video-based feedback in the teaching process. Video-based feedback also makes it easier for teachers to provide models of behavior or activities that students can follow appropriately. In addition, this video-based feedback provides students with the opportunity to evaluate content repeatedly in order to improve students' writing skills.

Video-based feedback with traditional teaching is also can to enhance the quality of students' writing components which can be seen from the increase in scores in the posttest phase. Video-based feedback combined with traditional teaching is still able to enhance the quality of students' writing components. This finding is in line with previous research which found that the use of technology in feedback was able to correct students' misconceptions about their ability to write argumentative texts because technology provides opportunities for teachers to explore more and more intensively the instructions delivered to students (Buhl-Wiggers et al., 2023; Khojasteh et al., 2021). This finding is also strengthened by the theory that feedback with multiple experiments applied in formative evaluation is able to encourage students to review more and correct students' misunderstandings in learning concepts or teacher instructions. The advantage of video-based feedback is that it can make students' memories stronger (Afzali & Izadpanah, 2021; Roitsch et al., 2021). Students can express concepts they have learned even though learning and evaluation have been given for quite a long time. Another finding from this research is that video-based feedback has a different impact on each component of students' writing. Video-based feedback with traditional teaching can also improve the quality of students' writing components. The component that shows the most significant improvement is the organizational component and is followed by the language component, vocabulary. The component that

shows the smallest improvement is the mechanical component of the sentence. The mechanical component of the sentence is least affected because this component has not been able to attract students' attention optimally. These findings are in line with previous research which found that most students focused more on high-level improvements such as idea organization, content, language use rather than low-level improvements such as letter use, punctuation, and spelling (Wang et al., 2018; Wassinger et al., 2022; Zou & Xie, 2019).

Improvements were also seen in writing skills in the video-based feedback experimental group with traditional teaching. This shows that this video-based feedback can improve students' abilities regardless of different teaching methods. This research is also strengthened by the results of previous research which found that video-based feedback was able to improve the quality of students' writing in higher education without having to meet directly with the lecturer (Challob, 2021; Roehling, 2018). Through video-based feedback, students can make improvements to their writing by repeatedly viewing the feedback. Script deficiencies flagged by the teacher through video-based feedback can be observed more clearly and personally. Students' views on this video-based feedback are overall positive and able to improve student performance in a better direction. However, this video-based feedback also has disadvantages, including that there are still students who have difficulty accessing feedback video files, devices that do not support it (Parr et al., 2022; Roehling, 2018). Based on these shortcomings, this video-based feedback requires sophisticated software, allowing teachers to improve, longer video duration which will overcome the shortcomings of this video-based feedback.

The influence of video-based feedback with the reverse teaching method has a more significant impact compared to the influence of video-based feedback with the traditional teaching method. This difference can be seen in the increase in the average score from the pretest phase to the posttest phase of the two experimental groups. These findings indicate that video-based feedback is more effective in improving the quality of writing components and students' writing abilities combined with flipped teaching compared with traditional teaching (Mohamadi Zenouzagh, 2018; Price, 2020). This happens because students in traditional teaching groups do not have access to repeated feedback that can be accessed in their respective homes. Students who get repeated access in flipped teaching are able to outperform all components of students' writing in traditional teaching because of aspects of the improvement process that students carry out more effectively in flipped teaching. This finding is reinforced by similar research, namely that the advantage of using technology in providing feedback is that the time given to provide more individual feedback to students (Alobaid, 2020; Nuckles et al., 2020; Rogers & Graham, 2020). The feedback provided is a combination of written instructions, corrections, and audio comments from very detailed and individual teachers that will help students make appropriate improvements.

Video-based feedback with flipped and traditional teaching can improve the quality of writing components and students' writing abilities. Although both were able to improve the quality of the writing component and students' writing abilities, video-based feedback with flipped teaching had a more significant impact on the quality of the writing components and students' writing abilities compared to traditional teaching. The component that shows the most significant improvement is the organizational component and is followed by the language component, vocabulary. The component that shows the smallest improvement is the mechanical component of the sentence. The mechanical component of the sentence is least affected because this component has not been able to attract students' attention optimally. Teacher feedback comments packaged with videos can have a positive impact on students' level of understanding of writing concepts and their shortcomings, so they can develop their writing skills. In feedback, teachers also get the opportunity to provide comprehensive feedback and give students the opportunity to learn it repeatedly. Video-based feedback explores all students' strengths and weaknesses, so students know their weaknesses and make them more motivated to improve the quality of their writing. Video-based feedback is also able to provide instructions for students to know clearly and definitely each part that needs to be improved and how to fix it. This research has implications for teachers' abilities to modify feedback with media to create innovative and effective learning processes in improving product quality and student abilities. However, the use of video-based feedback requires prior training for teachers to be able to use it optimally. This research has several limitations, including that the sample involved is still small, focuses on quantitative data, and only focuses on how feedback is given, not on student preferences in receiving feedback. Based on these limitations, the researcher recommends several suggestions, namely that a larger and broader sample size is needed, for example, try applying feedback at various levels to determine the impact of video-based feedback on students

at various levels. Furthermore, qualitative data collection is needed to examine students' views of video-based feedback in flipped and traditional teaching modes, and further research is needed on students' preferences for teacher-provided feedback.

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DETERMINATION OF FACTORS AFFECTING THE SATISFACTION OF INSTRUCTORS IN DISTANCE EDUCATION USING CHAID ANALYSIS

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ABSTRACT

The most effective stakeholders of distance education processes are the instructors who carry out and manage the teaching processes. Instructors are expected to master the process in order to carry out distance education effectively and efficiently. One of the most important factors affecting this situation is the satisfaction level of the instructors who gave courses in the distance education process. Thus, this study aims to determine the factors that affect the satisfaction levels of instructors. A satiscaftion survey consisting of 11 questions was administered to 741 instructors who gave courses in the distance education process at a Turkish State University. The survey data were analyzed by CHAID method. The findings indicated that the general satisfaction of the instructors was at a good level. Also, it was determined that the suitability of the course for distance education, the willingness to teach online, gender, Internet Access/speed, and age played an important role in instructors' satisfaction levels.

Keywords: Distance education, instructor, satisfaction, CHAID analysis.

INTRODUCTION

The priority of educational institutions applying Distance Education system is to create high quality online learning environments suitable for the target audience. However, in the efficiency of these environments, it is important to have qualified instructors who are motivated about online teaching, have a good satisfaction level and can realize effective teaching process in online environments (Bolliger, Inan, & Wasilik, 2014). Based on the fact that universities are the education level where distance education processes are most intensively applied, Moody (2011) put forward six themes explaining the online teaching strategies of instructors involved in the distance education process and their satisfaction levels in this context. These include classroom structure, quality classroom-related audio/video technology, web-enhanced components, technology-related staffing issues both on-site and off-site, educational and IT staffing for instructors, and transactional distance. Cheok and Wong (2015) also mentioned that flexibility, interactivity, perceived usefulness, and perceived ease of use should be taken into account in educational environments and that instructors and the organization should

work in cooperation for the effective use of the learning system. In order to ensure these conditions, it is important to take into account the demands of instructors regarding the realization of distance education (Gok & Kilic-Cakmak, 2020). In addition, it is critical to examine the components involved in the process well in order to ensure instructor satisfaction and continuity in distance education processes (Cheok & Wong, 2015).

Among the factors affecting the distance education process, especially the instructor satisfaction level has a direct impact on the efficiency of the system (Yengin, Karahoca, & Karahoca, 2011) and is also a major factor in terms of achieving the targeted learning outcomes (Bolliger & Wasilik, 2009; Bolliger, Inan, & Wasilik, 2014). Especially in meeting student expectations and realizing their performances at the targeted level, it is important for instructors to make qualified course design in accordance with the nature of distance education and to integrate effective technology into their courses. Acquiring and putting these competencies into practice has the effect of increasing the efficiency of the process and accordingly the satisfaction of the instructors (Palmer, 2011; Keengwe, Diteeyont, & Lawson-Body, 2012). However, the employment of these competencies requires instructors to make more effort from the design to the implementation and evaluation of the learning process compared to face-to-face education (Ng, 2005). Because the instructor role in online environments requires much different experiences for instructors than face-to-face education (Kapucu & Adnan, 2018). Therefore, in the distance education process, while instructors take an active role in the execution of the courses, they also have to provide active support to the process as content developers. Therefore, they are responsible for all the processes that need to be realized before, during and after the course (Gok & Kilic-Cakmak, 2020).

Instructors should be encouraged towards distance education systems and their satisfaction levels should be increased so that they can adapt to distance education; due to their roles in distance education processes and the responsibilities they have, especially at higher education level (Oyefolahan & Abdallah, 2014). For this reason, while addressing the factors affecting the resistance of the instructors to change, it is also important to determine the factors affecting their satisfaction and motivation. In this context, it is necessary to examine the relevant factors (Oyefolahan & Abdallah, 2014; Friedman, Bonzo, & Ketcham, 2017).

Gurer, Tekinarslan, and Yavuzalp (2016) emphasize in their research that taking into account the factors that positively affect the satisfaction levels of instructors in distance education processes not only makes the teaching processes more effective and efficient, but also positively affects instructor and student satisfaction. Although Moody (2011) states that effectiveness and efficiency can be achieved through technology and infrastructure in distance education environments to be created for instructors and students, it is emphasized in the literature that these are not sufficient. For example, Breittholz (2018) concluded in his study that the quality of distance education and therefore the satisfaction levels of instructors are also affected by factors such as teaching experience, assignment, accessible technical support, perceptions of online education, technical knowledge, and lack of self-efficacy. It is important to design effective support mechanisms, especially since general competencies are the elements that need to be supported. Many studies show that these support services are effective on user satisfaction. For example, Rios-Parnell (2017) found that instructors were satisfied with the training they received for communication skills for distance education, the use of Learning Management System (LMS) and the use of social media in the context of technology use in education, but stated that instructors need more technical support and training. In this context, it is of particular importance for educational institutions where distance education is implemented to prepare their instructors for this process by conducting in-service trainings, workshops, meetings and sample training practices; to determine and develop the knowledge and skills for their new duties and the competencies they should have. It is also necessary to ensure the continuity of trainings in the continuation of the process (Kapucu & Adnan, 2018). Again, increasing the continuity of use with the steps taken to eliminate possible systemic problems (freezing of the screen, involuntary disconnection of the session, etc.) that can be experienced in the use of LMSs in general will also contribute to increasing instructor satisfaction (Ates & Guyer, 2016).

When the literature is examined, regarding the variables affecting the satisfaction levels of instructors in their performance and productivity in distance education processes. Alea, Fabrea, Roldan, and Farooqi (2020) concluded in their study that instructors were ready to switch to distance education, but they felt inhibited due to the lack of necessary equipment. Similarly, Gurer, Tekinarslan, and Yavuzalp (2016) stated that instructors are resistant to teaching entirely through distance education and the reason for this resistance is the lack of experience. Emelyanova and Voronina (2014) reported that educators who are resistant to distance education may find it difficult or impossible to implement distance education in a number of subject areas. In

addition, it was determined that educators had complex feelings towards distance education and did not have a common view in terms of quality and effectiveness. Considering some of the results obtained, other factors that negatively affect instructors' satisfaction levels and thus their teaching in distance education include the lack of widespread use of distance education, lack of sufficient infrastructure, insufficient IT literacy, prejudice against distance education, workload, insufficient institutional support, and low participation and interest of students in online courses (Ustun, 2011; Gurer, Tekinarslan, & Yavuzalp, 2016; Ozgol, Sarikaya, & Ozturk, 2017). As emphasized in the literature, there are different factors affecting instructor resistance. In the context Lloyd, Byrne, and McCoy (2012) identified four important factors regarding the resistance of instructors in their research. These are listed as interpersonal, institutional, educational and technological barriers. It is of great importance to design the process by taking these four factors into consideration, especially in the transition stages to distance education. Eliminating the resistance of instructors and increasing their satisfaction levels will positively affect the effectiveness and efficiency of the teaching process.

It is predicted that if instructors are able to carry out distance education processes effectively and efficiently, their satisfaction levels will also increase. One of the most important processes that can be employed in this context is the good planning of support services. Many researchers refer to this situation (See Fernandez, Santos, & Javier, 2018; Hodges, Moore, Lockee, Trust, & Bond, 2020; Torun, Oksuz, Ak, & Gokdas, 2020; Toquero & Talidong, 2020). Getting the opinions of instructors while planning support is valuable in terms of the planned execution of the process (Gok & Kilic-Cakmak, 2020). In the planning and implementation of all these processes, the satisfaction levels of instructors are important because they are key users in distance education. When we look at the studies based on instructor satisfaction in distance education, it is seen that many different variables are examined, so there are many components that need to be taken into account on satisfaction. For example, Kapucu and Adnan (2018) found that significant differences can be seen according to gender and age. Gay (2016) found that instructors' readiness for distance education has a positive effect on their satisfaction. In addition to these components, when examined in general; attitude, anxiety, self-efficacy, innovation, quality of information, experience, social presence, working environment, commitment to work, ease of access, course load, workload, compensation, promotion, incentive policy, prestige, right to use, quality of the system, management support, in-service training, support services (VanHorn, 2006; Palmer, 2011; Cheok & Wong, 2015; Friedman, Bonzo, & Ketcham, 2017; Ozgol, Sarikaya, & Ozturk, 2017; Breittholz, 2018) are also effective on satisfaction.

In general, it can be said that instructor satisfaction plays a determining role as a variable in distance education processes. Structuring the distance education process and effectiveness of the applications to be realized in this context, determining the factors affecting instructors satisfaction levels are considered important and necessary in terms of the effectiveness, efficiency and controllability of the process. Another important point is that qualified learning environments should be ready in a feasible structure in the conditions created by the emergency distance education application that is compulsory in cases such as any pandemic. Because there are unique conditions created by the design and implementation of distance education processes applied in emergencies. This situation also necessitates a serious readiness. On the basis of these importance and necessities, the main purpose of the research is to determine the variables that affect the satisfaction levels of the instructors who experience the distance education process. In line with this main purpose, answers to the following research questions were sought.

1. What is the level of satisfaction of instructors with the distance education?
2. What are the factors and their effectiveness levels that affect the satisfaction of instructors regarding functionality, communication, and support of distance education portal?

METHOD

Research Design

The descriptive (survey) model, one of the quantitative research methods, was used in the study. With the descriptive model, it is possible to examine and define the phenomena that are assumed to still exist (Karasar, 2012; Sonmez & Alacapinar, 2018). In this way, it will be ensured to reveal the variables that affect the satisfaction levels of the instructors who experience the distance education process regarding the distance education process.

Participants

A total of 741 instructors who gave courses in the distance education process at a Turkish State University participated in the study. 350 (47%) of the participants were female, 394 (53%) were male, and their ages ranged between 24-66 years.

Data Collection

Distance Education Portal Satisfaction Survey, consisting of 11 questions, was used to collect the data. Exploratory factor analysis (EFA) was conducted at the first stage for the "Distance Education Portal Satisfaction Scale" developed by the researchers. First and second level confirmatory factor analysis (CFA) was applied to confirm these results. As a result of the analysis, the scale showed a structure with 11 items and three dimensions. The first dimension was defined as Functionality (5 items), the second dimension as Communication (3 items) and the third dimension as Support (3 items). The three-dimension survey explains 65% of the total variance. The Cronbach Alpha value of the scale was determined as 0,84.

Data Analysis

Based on the data collected from 741 instructors who experienced the distance education process, Chi-squared Automatic Interaction Detection (CHAID) analysis was used to determine the combined categories and subgroups of the independent variables (age, gender, level of the education program, internet access environment, internet speed problem, online education experience, suitability of the course for distance education and willingness for distance education) to reach the factors affecting the satisfaction levels of the instructors regarding the portal. Here, it is aimed to determine the level of influence of independent variables on the dependent variable. CHAID analysis is an analysis that divides the dependent variable into homogeneous sub-branches that can best explain the dependent variable (Dogan, & Ozdamar, 2003) and models the interaction of the independent variables that show the highest correlation with the dependent variable by establishing various iteration algorithms in each sub-branch (Kayri & Boysan, 2007). Therefore, the tree structure created with CHAID analysis provides the opportunity to examine the independent variables affecting the dependent variable in detail (Emin, Kayri, & Dogan, 2024).

FINDINGS

The general distribution of the participants is given in Table 1. It is seen that the majority of the participants are between the ages of 35-45. A significant number of the participants (f:310) who teach distance education courses have experience in both undergraduate and postgraduate level courses. The majority of the participants (f:642) who conducted their courses through distance education method carried out these tasks from their homes. It can be said that the number of participants who had serious internet speed problems during the process was low (f:23). It can be said that the proportion of participants who have previous experience of teaching courses through distance education method is low (f:60). It is seen that the majority of the participants are of the opinion that the course they give can be carried out by distance education method and they are willing about distance education.

Table 1. Distribution statistics

Age	**f**	**%**
26-35	113	15,2
36-45	315	42,5
46-55	230	31,0
56-65	83	11,2
Total	741	100,0
Gender	**f**	**%**
Male	391	52,8
Female	350	47,2
Total	741	100,0
Level of the education program implemented	**f**	**%**
Associate	190	25,6
Undergraduate	179	24,2
Postgraduate	15	2,0
Undergraduate-Postgraduate	310	41,8
Associate-Undergraduate-Postgraduate	12	1,6
Associate-Postgraduate	35	4,7
Total	741	100,0
Internet access environment	**f**	**%**
Internet access at home	642	86,6
Mobile internet access	20	2,7
Internet access at work or school	75	10,1
Other facilities around me	4	,5
Total	741	100,0
Internet speed problem	**f**	**%**
Never ever	200	27,0
Rarely	351	47,4
Sometimes	167	22,5
Usually	20	2,7
Always	3	,4
Total	741	100,0
Previous online education experience	**f**	**%**
Yes	60	8,1
No	681	91,9
Total	741	100,0
Suitability of the course for distance education	**f**	**%**
Yes	237	32,0
Partially	426	57,5
No	78	10,5
Total	741	100,0
Willingness for distance education	**f**	**%**
Yes	188	25,4
Partially	378	51,0
No	175	23,6
Total	**741**	**100,0**

Participants' level of agreement with the dimensions of the satisfaction scale is given in Table 2. It is seen that the highest level of satisfaction is in the Functionality dimension with the option "Very satisfied" (X:4,37), followed by the Support dimension at the second level with the option "Satisfied" (X:4,04), and the third level is in the Communication dimension with the option "Satisfied" (X:3,60), although the average value is lower.

Table 2. Levels of agreement with the dimensions of the satisfaction scale

	N	X
F1 (Functionality)	741	4,37
F2 (Communication)	741	3,60
F3 (Support)	741	4,04

Functionality

The variation of participants' satisfaction levels regarding the functionality factor according to independent variables is given in Figure 1.

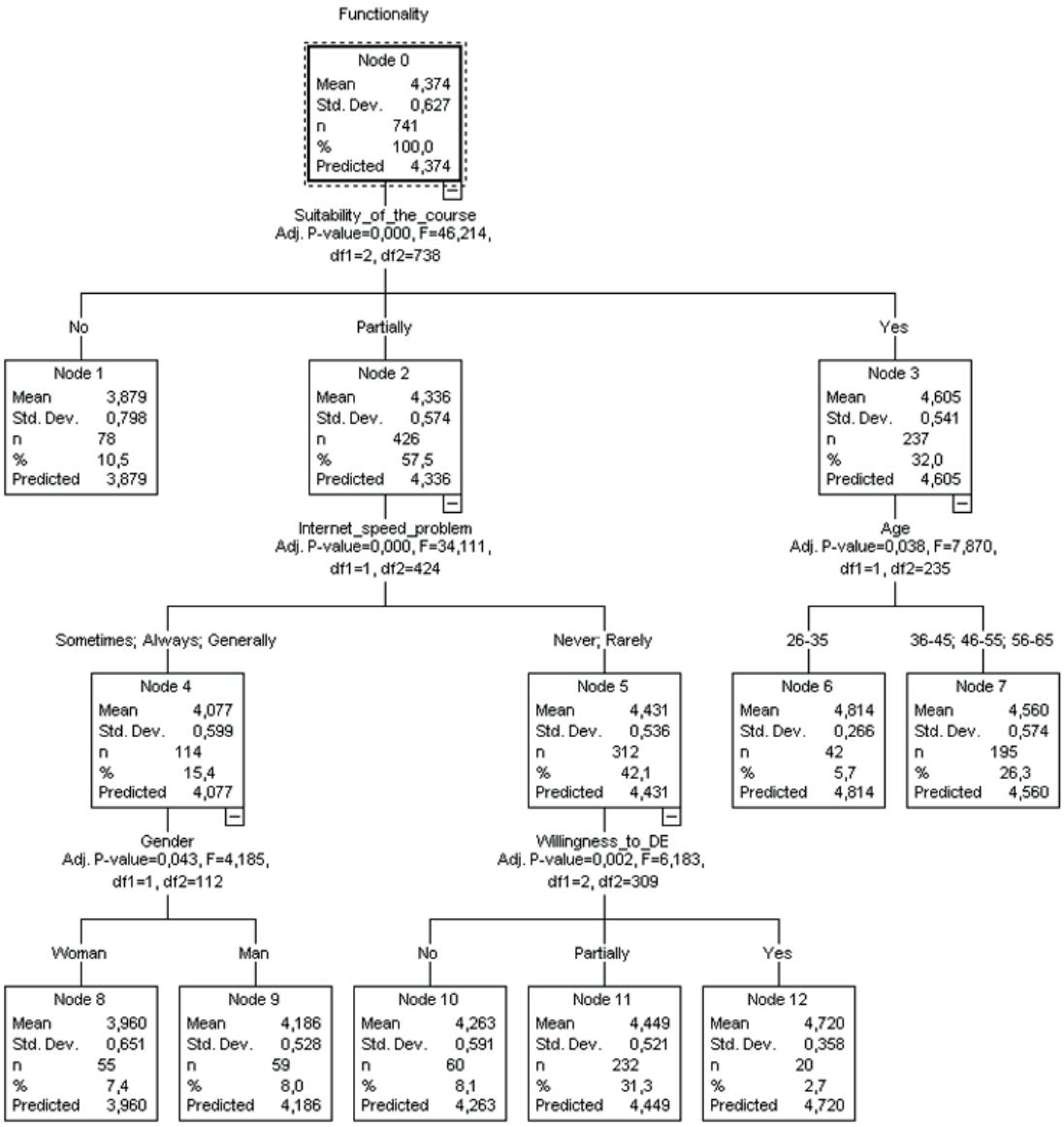

Figure 1. Tree structure for the functionality factor

When the tree structure formed as a result of the CHAID analysis is examined, it is seen that those who think that the course they teach is suitable for distance education find the distance education portal more functional in the distance education process (F(2, 738)=46.214; p<0,001). In other words, the main predictor of the functionality factor is the suitability of the course for distance education. Instructors who think that the course is not suitable for distance education have lower satisfaction levels regarding the functionality factor (X: 3,88).

Age was found to be a significant predictor in the satisfaction levels of instructors who thought that their courses were suitable for distance education process (F(1, 235)=7,870; P<0,001). It was found that the satisfaction level of the younger instructors was higher (X:4,81) than the older instructors.

Among the instructors who think that their courses are partially suitable for distance education, the predictor showing the level of satisfaction with the functionality of the distance education portal is the status of having internet speed problems (F(1, 424)=34,111; p<0,001). Instructors who do not have internet speed problems think that the distance education portal is more functional (X:4,43) than those who have speed problems. Among the instructors who do not have internet speed problems, the level of willingness to distance education is an important predictor (F(2, 309)=6.183; p<0,005). Those with a high level of willingness for distance education (X:4,72) find the distance education portal more functional than those with a low level of willingness (X:4,26). Gender was found to be a significant predictor among the instructors who experienced speed problems F(1, 112)=4,185; p<0,005). It was determined that male instructors (X:4,18) who had internet speed problems had higher satisfaction levels with the functionality of the distance education portal than female instructors (X:3,95).

Communication

The tree structure showing the satisfaction levels of the instructors regarding the communication dimension is given in Figure 2.

When Figure 2 is examined, it is seen that the willingness factor is the most important predictor of the satisfaction levels of the instructors regarding the communication dimension (F(1, 739)=13,492; p<0,005). The satisfaction level of the instructors who are willing to distance education regarding the communication factor is X:3,97, which is higher than those who are not willing. In the satisfaction levels of the instructors who were not willing to distance education regarding the communication sub-dimension, having speed problems on the Internet was found to be an important predictor (F(1, 551)=10.411; p<0,005). Another determi-

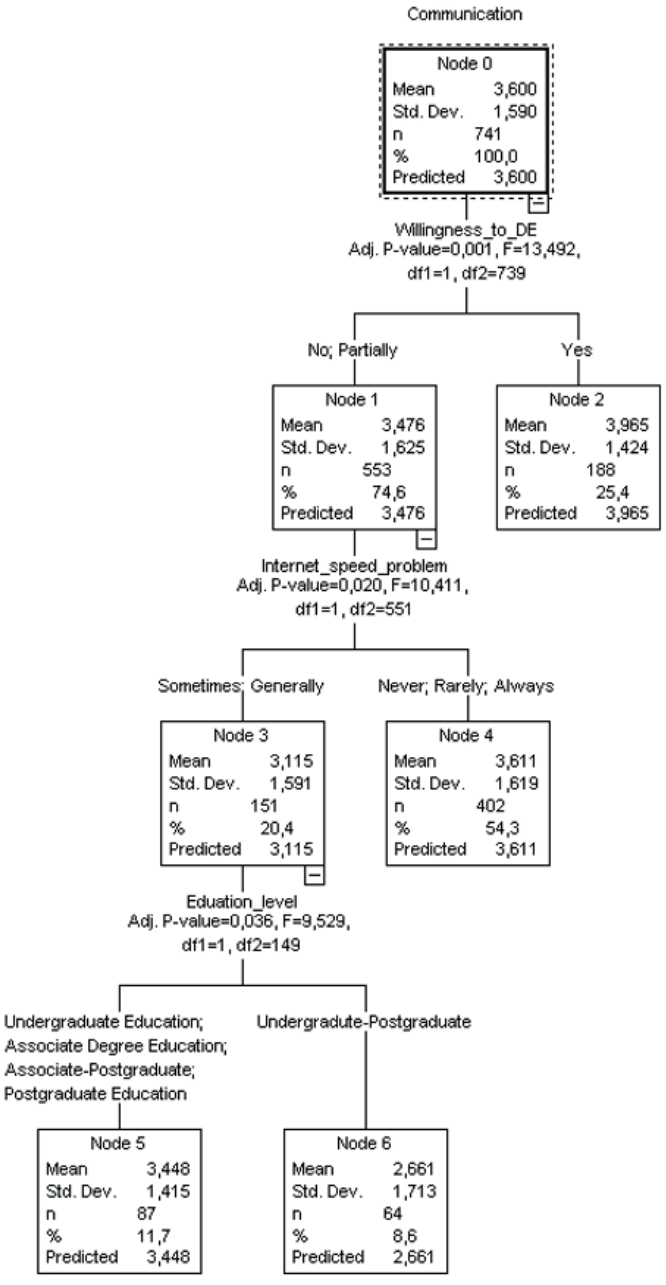

Figure 2. Tree structure for the communication factor

nant predictor of the satisfaction levels of the instructors who had speed problems on the Internet regarding the communication dimension was the education level of the instructors (F(1, 149)=9,529; p<0,005). The satisfaction levels of the instructors who teach only at undergraduate and graduate level are lower than the instructors who teach at more than one level (such as associate, undergraduate, graduate).

Support

The tree structure showing the satisfaction levels of the instructors regarding the support sub-dimension is given in Figure 3.

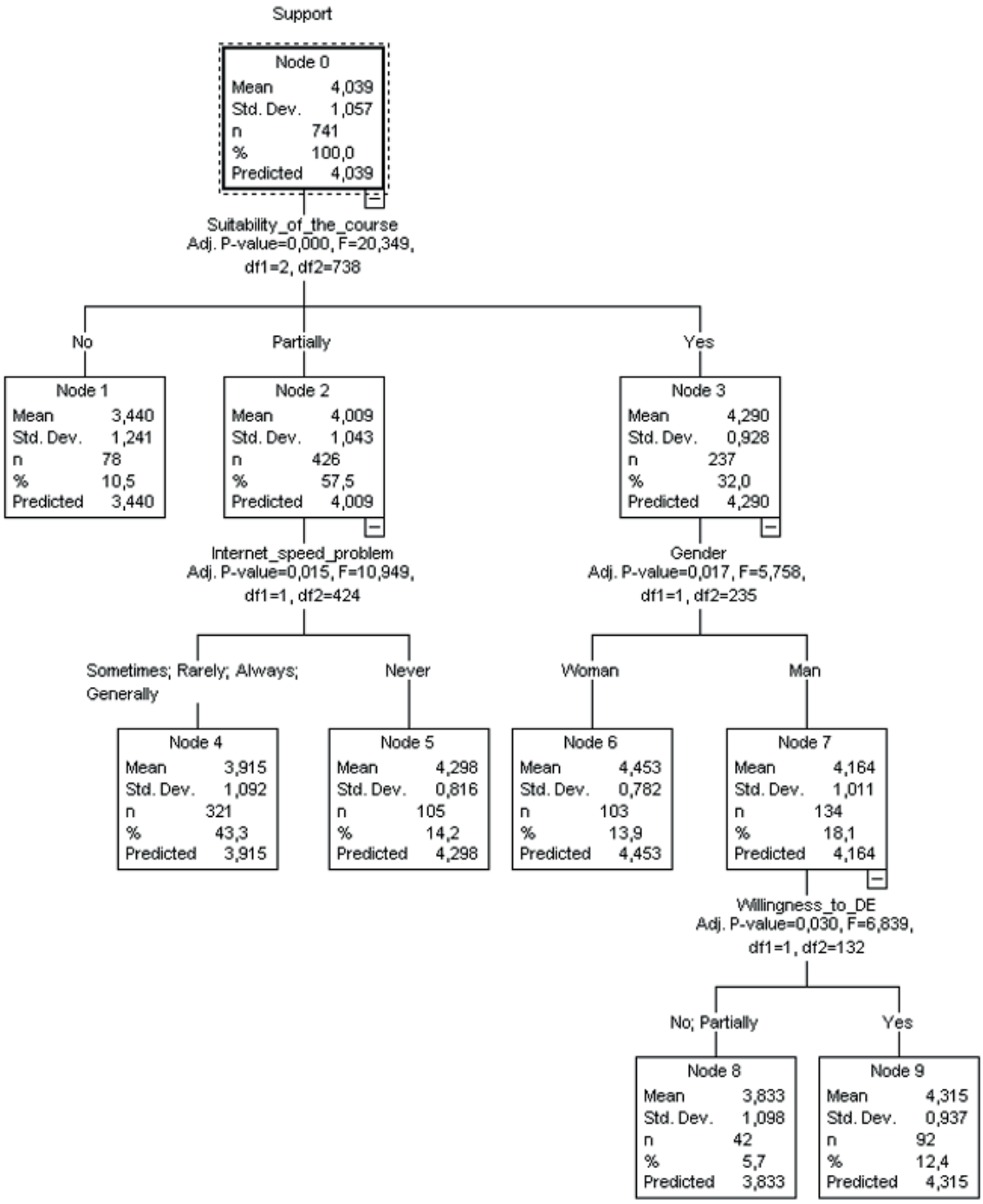

Figure 3. Tree structure for the support factor

The main predictor affecting the satisfaction levels of the instructors regarding the support dimension was found to be the suitability of the course given by the instructor for distance education (F(2, 738)=20,349; p<0,001) (Figure 3). Instructors who think that the course they teach is suitable for distance education have a higher level of satisfaction with the support dimension (X:4,29). Those who think that the course given by the instructors is partially (X:4,00) or not at all (X:3,44) suitable for distance education have lower satisfaction levels regarding the support dimension.

The predictor determining the satisfaction levels of the instructors who think that their courses are suitable for distance education is gender (F(1, 235)=5,758; p<0,005), (Figure 3). The satisfaction level of female instructors regarding the support factor (X:4,45) is higher than that of male instructors (X:4,16). When the tree structure of the gender variable was analyzed, the satisfaction level of male instructors regarding the support dimension was found to be a significant predictor (F(1, 132)=6,839; p<0,005), and the satisfaction level of instructors who were willing to distance education was X:4,31, which was higher than the satisfaction level of instructors who were not willing and partially willing to distance education.

For the satisfaction levels of the instructors who think that their courses are partially suitable for distance education regarding the Support dimension, having internet speed problems was also found to be a predictor (F(1, 424)=10,949; p<0,005) (Figure 3). It was determined that the satisfaction level of the instructors who did not experience internet speed problems was X:4,30, which was higher than the satisfaction level of the instructors who experienced internet speed problems (X:3,91).

DISCUSSIONS AND CONCLUSION

The results obtained based on the findings regarding the satisfaction levels of the instructors regarding the functionality, communication and support dimensions of the distance education portal and the variables predicting the satisfaction levels are discussed below.

Satisfaction

As a result of the research, it was concluded that the satisfaction levels of the instructors regarding the "functionality" dimension of the distance education portal were high. In the second place is the satisfaction level regarding the "support" dimension, which is above average. In the third place, the level of satisfaction with the "communication" dimension is above average.

The fact that the distance education portal is designed in a structure that instructors will need in the learning-teaching processes they carry out in online environments is reflected in the satisfaction levels regarding the functionality dimension. Meeting the expectations of the instructors leads to an increase in their satisfaction level. Liu and Zhang (2021) emphasize that when the quality perceived by the teacher increases, teacher satisfaction will also increase and that high teacher expectations will increase the perceived quality and that teacher satisfaction can be indirectly increased by improving teacher expectations. Some studies on students have also found that the quality of the online learning system has a positive effect on student satisfaction (Costa et al., 2016; Aparicio et al., 2017; Cidral et al., 2018).

Functionality

When the tree structure formed as a result of the CHAID analysis was examined, it was concluded that the most important predictor for the satisfaction levels of the instructors regarding the distance education portal functionality factor was the suitability of the course given for distance education.

Age is an important predictor for the satisfaction levels of instructors who think that their courses are suitable for distance education process. It was determined that the satisfaction levels of the younger instructors were higher than the older instructors regarding the functionality factor.

Among the instructors who think that their courses are "partially suitable" for distance education, the level of satisfaction with the functionality of the Distance Education Portal is an important predictor of having internet speed problems. Instructors who do not have internet speed problems find the Distance Education

Portal more functional than those who have speed problems. Among the instructors who do not have internet speed problems, willingness to distance education is the prominent predictor. Among the instructors, those who are willing to distance education find the distance education portal more functional than those who have a low level of willingness. Gender is an important predictor among instructors who have internet speed problems. Male instructors who have internet speed problems have higher satisfaction levels with the functionality of the distance education portal than female instructors.

When the results obtained regarding the satisfaction levels of the instructors in the context of the functionality of the distance education portal used in the distance education process and the variables predicting the satisfaction levels are evaluated in general, it can be said that the most important predictor affecting the "Functionality" factor is the evaluation of the course conducted by the instructor in a structure suitable for the distance education method. The fact that the course is not considered suitable for distance education by the instructors can be evaluated in two sub-dimensions. The first one is the fact that the course content is application-oriented and requires face-to-face interaction, and the second one is that the course content is designed in a structure specific to face-to-face learning environments. Although in the latter case, course content can be designed and maintained in accordance with online learning environments, course design specific to distance education is a pedagogical issue that requires special competence. Goodyear (2015) also states that the quality of instruction depends largely on making the right pedagogical and technological decisions. Varvel (2007) states that the course design process is an instructional plan that includes course objectives, instructional strategies, activities and assessments in accordance with the objectives, while Young (1997) emphasizes that the design of course content in an online course structure requires more technical competencies such as the design of educational websites and interactive learning environments. Therefore, instructional design is the process of making the right decisions and plays an important role in the success of online learning. Therefore, instructional design skills of instructors need to be developed (Winfield, Mealy & Scheibel, 1998).

When evaluated in this context, the proficiency levels of instructors in instructional design will affect the design of course content in accordance with online learning environments. It is evaluated that instructors who cannot design their courses in a structure suitable for online environments may have a negative impact on the efficiency and satisfaction levels of the teaching process. The suitability of the course for distance education varies according to age, internet speed, willingness towards distance education and gender variables. Among the instructors who showed a high level of participation regarding the delivery of their courses through distance education, the fact that younger instructors expressed a positive opinion can be considered as a result of their positive approach to new technologies and, in this context, their higher level of adaptation to technology integration in education. In the context of the use of Information and Communication Technologies (ICT) in online environments, Liu and Zhang (2021) state that learning environments are becoming increasingly complex as online learning requires more intensive use of ICT. Therefore, this situation highlights the level of competence in ICT. The lower satisfaction levels of female instructors compared to male instructors, especially among the instructors who experienced internet speed problems, may be due to their inability to cope with technical issues, their lower attitudes towards information technologies, and their partially lower ability to utilize alternative solution possibilities. Prado, Canon, Martin, and Canton (2020) found in their study that men were more confident in solving problems related to technologies and used them more for technical and educational purposes. On the other hand, they concluded that women use technologies mostly for social purposes. In a meta-analysis study conducted by Cai, Hayrani, and Du (2017) and covering the period between 1997 and 2014, it was concluded that women's attitudes towards technology use were lower than men's (although there was an improvement over the years). Again, Yau and Cheng (2012) state that men appear to be more confident and knowledgeable in using technology-related skills. Alghamdi et al. (2020) emphasize that men have better technical skills than women and are better able to use technologies that require technical skills. Borup and Stevens (2016) state in their research that teachers who do not have technological skills may not be able to teach effectively in online environments. Although some studies in the literature indicate that there are different findings regarding the effect of gender on educators' digital literacy levels (Antoino et al., 2020; Gungor & Kurtipek, 2020; Gokbulut, 2021; Ocak & Kusserin, 2024); the findings of the recent study conducted by Aretouli et al. (2024) in four European countries show that there may be gender differences in educators' thoughts, attitudes and preferences about distance education. Again, Scherer, Siddiq, Howard, and Tondeur (2023), in their study on teachers'

readiness for online teaching and learning, found that there was a difference between genders in favor of men. Sobieraj and Kramer (2020) also found that men and women perceived themselves differently when asked what skills they had and how confident they were in performing a technology-related task.

Communication

The most important predictor of instructors' opinions on the communication dimension in the context of their satisfaction with the distance education portal they use in the distance education process is their level of willingness to distance education. The most important variable predicting the satisfaction levels of the instructors who are not willing and partially willing to distance education regarding the communication factor is the internet speed problem of the instructors. Instructors who mostly and sometimes experience Internet speed problems have lower satisfaction levels regarding the communication variable. On the other hand, the most important predictor affecting the satisfaction levels of instructors who mostly and sometimes experience internet speed problems is the level of education taught by the instructor. Instructors who teach at both undergraduate and graduate levels have lower satisfaction levels with the communication factor.

When the satisfaction status of the instructors regarding the distance education portal used in the distance education process is examined in the context of the communication dimension, the results obtained in the context of the satisfaction levels and predictors of the instructors are generally evaluated. The high level of willingness of the instructors for distance education positively affects the satisfaction levels related to the communication factor. The level of willingness towards distance education is affected by the internet speed. The existence of a learning environment that can provide the interaction speed required by the course and where there will be no disconnections and communication disruptions in the course is naturally reflected in the level of satisfaction with the communication factor. However, it can be said that the situation of teaching at undergraduate and graduate level among the instructors who have internet speed problems negatively reflects on the satisfaction levels of the instructors regarding the communication factor. This situation is considered as a reflection of the problems arising from the diversification of communication needs due to the student profile and the course. Karadag et al. (2021) stated that the level of acceptance and utilization of distance education systems by instructors has a positive effect on student satisfaction.

Support

The most important predictor of the satisfaction level of the instructors regarding the "Support" dimension is the instructors' level of "considering the course suitable for distance education". The significant predictor of the satisfaction level of the instructors with a high level of "seeing the course as suitable for distance education" is gender. The satisfaction level of female instructors is higher than that of male instructors. The most important variable predicting the satisfaction level of male instructors is their willingness for distance education. The satisfaction level of those who are willing to teach their courses with distance education method is higher. The most important variable predicting the satisfaction levels of the instructors who think that the course given for the support dimension is partially suitable for distance education is the status of having Internet speed problems. The satisfaction levels of those who do not have Internet speed problems are higher than those who have speed problems.

It was concluded that there are different variables affecting the satisfaction levels of instructors regarding the distance education portal used in the distance education process in the context of the Support dimension. When these results are evaluated in general, it can be said that the fact that the course given is suitable for distance education, the internet infrastructure is fast in receiving and sending data, and the willingness to teach with distance education method positively affects the perception of the support services offered. The instructors' evaluation that the course they teach is suitable for distance education method also increases their positive attitude towards distance education and their motivation to solve possible problems and overcome difficulties. Boumadan Soto-Varela, Ortiz-Padilla, and Poyatos-Dorado (2020) also emphasized that the most important factor in online environments is content. Although the related study emphasized the timeliness and importance of the content, it is considered that the availability of the content through distance education may similarly affect motivation and, accordingly, satisfaction. On the other hand, Lee and Busch

(2005) state that instructors' willingness to participate in distance education can help universities to create or maintain distance education programs. Rockwell, Schauer, Fritz, and Marx (2000) emphasized that the revolution created by technology in education requires a paradigm shift and emphasized the necessity of a change in pedagogical approaches. In the context of keeping up with the change and the sustainability of the programs, the design of the courses given in the context of the sustainability of the programs in accordance with the distance education method will contribute to the positive reflection of the positive approaches of the instructors to the process and the support provided to the operation of the process.

The higher satisfaction levels of instructors who do not experience internet speed problems may be due to the fact that they have the opportunity to utilize technological opportunities more effectively. In this context, Henderson et al. (2017) emphasized that technology is important in the context of distance education experience and stated that it can increase satisfaction. Again, Karadag et al. (2021) state that the availability of technological resources for participation in distance education and the opportunities to access them affect the level of satisfaction. Harsasi and Sutawijaya (2018) also emphasize that technology quality in distance education is an important variable affecting satisfaction. The fact that instructors who do not experience speed problems have the opportunity to benefit from support services faster and/or do not need support services much in meeting the problems arising from internet speed may naturally be reflected in their satisfaction levels. Salisbury et al. (2002) state that technology and the ability to overcome interaction problems in distance education are important variables that can affect the distance education experience.

The satisfaction levels of the instructors who experience the distance education process at the higher education level with the distance education portal vary depending on the functionality of the portal, the communication opportunities offered by the portal in the process and the support opportunities provided in the process. The most important variables affecting these dimensions are the suitability of the course given for distance education within the scope of the functionality factor, the willingness of the instructors towards distance education within the scope of the communication factor, and the suitability of the course given for distance education within the scope of the support factor, as in the functionality factor. As mentioned above, these variables may vary depending on gender, Internet speed, access, level of education and age.

Similar and different possible variables related to the portals used in distance education processes need to be included in the scope of the research and studies with different environments and sample groups are needed. In addition, it would be useful to conduct studies in which qualitative data are also utilized in order to have in-depth knowledge on the subject. The results of such studies are important in terms of supporting the provision of more effective distance education environments and preparing for the future.

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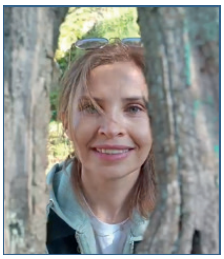

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BEYOND PLAY: SYSTEMATIC INSIGHTS INTO GAMIFYING EDUCATION ACROSS PEDAGOGICAL, PERSONAL, AND GAMIFICATION DIMENSIONS

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ABSTRACT

Different variables such as motivation, achievement, and engagement have been investigated in studies on gamification in the field of educational technologies. However, the obtained results differ, which emphasizes the need for studies based on concrete findings related to current trends and needs. In this study, we aim to reveal current research trends regarding gamification in education, identify current research needs, and make suggestions to guide future research through our systematic review. Instead of presenting limited results linked to a certain education level, learning environment, or variable, we share the results of research undertaken at all education levels and digital learning settings collectively and by categorizing (pedagogical, personal, and gamification) all the variables examined. One of the important results of the research is that gamification can be an alternative for solving the problems regarding motivation and participation in distance education. In conclusion, we provide practical suggestions for educators and instructional designers on how to apply gamified learning environments.

Keywords: Gamification, education, gamified learning environments, instructional technologies, systematic review.

INTRODUCTION

Games have changed with technological developments; whereas in the past, children played games on the streets where their houses were located, nowadays they mostly play games on the computer (Sahin & Samur, 2017). Thus, the digital game industry, which can rival the film and music markets, has emerged (Yilmaz & Cagiltay, 2004). The digital game industry has made great progress in recent years. As a result of these advances and developments, digital games have become an indispensable part of daily life, especially for children and young people. So much so that, according to the Video Games Industry statistics published in 2022, 3.2 billion people worldwide are active digital players. In the research findings, it is noteworthy that young people and children show great interest in digital games (Behnamnia et al., 2020). Therefore, digital games have been used for educational purposes for many years, based on the principle of "learning while having fun". However, some researchers have focused on transferring the positive aspects of digital games to non-game learning environments instead of using digital games for educational purposes (Dominguez et al., 2013). Thus, a new term that can be used in the field of education called "gamification" has emerged. Gamification is defined as the use of game-based mechanics, aesthetics, and game thinking to connect people, motivate them, improve learning, and solve problems (Kapp, 2012). Therefore, gamification can be

explained as the use of interesting features such as badges, experience points, leaderboards, and levels of games in non-game environments (Mese & Dursun, 2018). In gamified learning environments, students have fun in the learning process and encounter gradual challenges, thus increasing their interest and motivation for learning (Cheong et al., 2013). In addition, gamification features such as giving unexpected clues in the learning process (Dong et al., 2012) or providing the user with an advantage in time management (Fitz-Walter et al., 2011) affect motivation positively (Ozkan & Samur, 2017). Thus, with the use of gamification, the participation and motivation of the students are increased, and the learning process is transformed into a more active, interesting, fun, and qualified process (Sen, 2019). At this point, it is remarkable that the principle of "having fun while learning" is emphasized. However, when the research is examined, it is seen that the terms game-based learning and gamification are confused with each other. In fact, there is an important difference between game-based learning and gamification. Game-based learning aims at education through play, and these games replace learning; however, gamification does not replace learning; on the contrary, it focuses on making learning more participatory and sometimes overcoming some difficulties while learning (Codish & Ravid, 2014; Kim et al., 2009). Therefore, gamification has become popular in recent years and has been the subject of academic research since game elements are included in the learning process, and it is less costly than game-based learning. According to the Google Trends report, searches on gamification in education have increased in recent years (Figure 1).

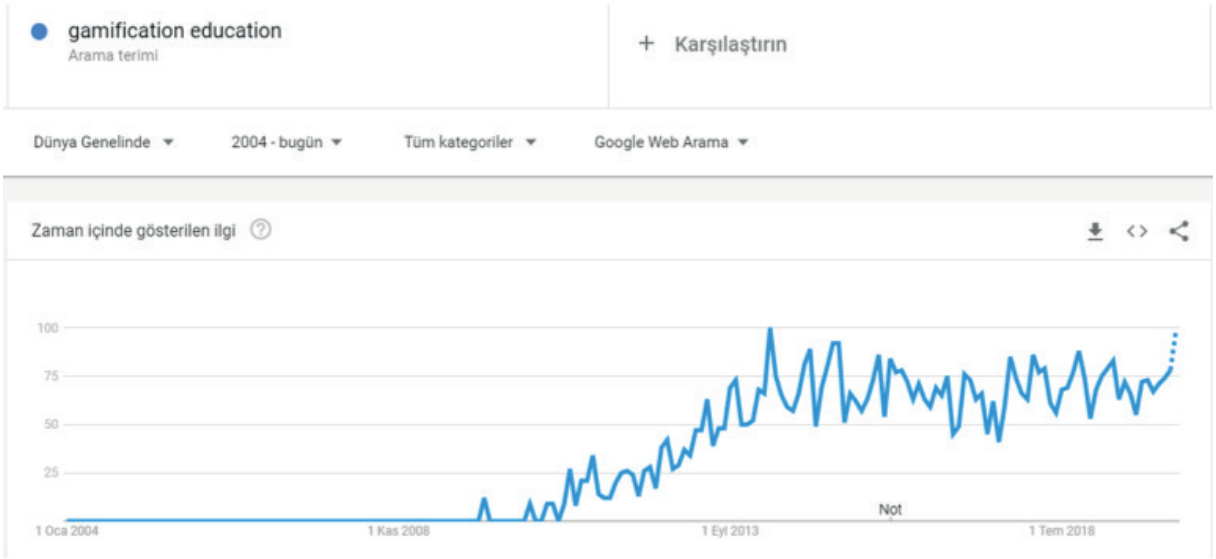

Figure 1. Interest in educational gamification over time

According to the graph in Figure 1, the sudden rise in the years 2010-2011 can be interpreted as the beginning of the transition from game-based learning to gamification. Gamification, which continued to increase in popularity after these years and peaked in 2013, continues to maintain its popularity and continues to be studied. Researchers have examined the potential benefits and challenges of gamification on many variables, such as academic achievement, motivation, participation, and satisfaction. However, there is still little evidence on how gamification should be implemented at different educational levels and on different digital platforms, how to deal with the challenges that may arise in this process, and the personalization of gamification. (Chugh & Turnbull, 2023; Ofosu-Ampong, 2020; Zeybek & Saygi, 2024). Majuri et al. (2018), Oliveira et al. (2022), and Almeida et al. (2023) state that more literature review studies are needed to fill this gap in the field. In addition, although it has been emphasized in research that the effectiveness of gamified learning environments may vary depending on personal characteristics, psychological needs, pedagogical factors, and the gamification elements used, we have not come across a systematic study that examines these factors together.

In this systematic review, we bring together research results on gamification at all education levels and digital learning environments by considering these dimensions in a holistic manner. The purpose of this study is to reveal the research trends and results on gamification in education in recent years by examining the studies on the use of gamification in education between the years 2016 and 2022. Considering that it is a subject that has emerged in recent years and is still being studied, putting together the research trends on gamification in education and the results obtained for the variables examined will contribute to the field in terms of determining the current situation and guiding future research. The research questions we seek answers to in this context are given below.

In gamification research,

- What are the definitions of gamification, and what are the common features of these definitions?
- What are the theoretical approaches and models based on gamification design?
- What research methods were used?
- What are the learning environments in which gamification is included?
- What are the game tools used in the gamification process?
- Which variables were examined, and what are the conclusions about these variables?

This systematic analysis can offer significant insights to researchers and individuals interested in the current state of research on the implementation of gamification in education. Additionally, it provides recommendations to educators and instructional designers on how to optimize the organization of gamified learning environments. In previous systematic review studies, researchers have analyzed different dimensions of gamification in education. Behl et al. (2022) aimed to reveal future research perspectives in the field of gamification and e-learning for young learners. Similarly, Khaldi et al. (2023) focused on providing a comprehensive overview of the current state of gamification in online learning in higher education. They also aimed to systematically explore different game elements and the gamification theory used in research. Freitas and Silva (2020) conducted a systematic literature review on the use of gamification in MOOCs (Massive Open Online Courses). Krath et al. (2021) examined the theoretical foundations used in gamification research, and Mora et al. (2017) conducted a systematic review of the design frameworks of gamification studies. Dehghanzadeh et al. (2019) and Shortt et al. (2021) analyzed the studies on the use of gamification in language learning. Zainuddin et al. (2020) presented the empirical findings of the literature in the field of gamification between 2016 and 2019. Denden et al. (2022) examined the role of learner characteristics in educational gamification systems. In their literature review, Oliveira et al. (2023) examined the results of studies covering the field of tailored gamified education. Almeida et al. (2023) carried out a thorough mapping analysis of the detrimental effects of game design components on education and learning systems. Dahalan et al. (2023) made a systematic analysis of the use of gamification in vocational education and training, while Ekici (2021) examined gamified flipped learning systems. All of these studies make a great contribution to the field; nevertheless, they contain results reached at a limited level of education, in a limited learning environment, and only for certain variables. In this study, we comprehensively present a systematic summary of the latest research trends and findings in the field of gamification in education by reviewing 108 articles. We also present the results of research conducted at all education levels in digital learning environments in a more comprehensive and holistic way by categorizing all the variables examined. In our research, we discuss the results obtained in the studies we accessed without making any limitations within the scope of education level, learning environment, and investigated variables by examining them in three dimensions (personal, pedagogical, and gamification). These dimensions cover many variables, such as students' personality characteristics, learning performances and academic achievements, interests, motivations, perceptions, satisfaction levels, participation rates, game elements, and player types. Therefore, this systematic review reveals the current situation in the field of educational gamification over a wider range while also providing solutions and suggestions to guide researchers, educators, and instructional designers.

METHOD

Research Model

In the research, we examined the research published between 2016 and 2022 in order to reveal the current research trends on the use of gamification in education in the field of educational technologies in recent years. We used a systematic review method to answer the research questions guiding our study. Systematic review is an empirical method to minimize preconceptions, while identifying, selecting, and synthesizing a summary of research studies (Moher et al., 2015). In this study, we follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as a protocol-driven system to document the a-priori road map (Crompton et al., 2021).

Data Collection Process

We conducted an extensive electronic search in the databases of Science Direct, Taylor & Francis Online, and Springer Link. In this process, we only considered the articles published in journals indexed by Web of Science (ESCI, SCI, SSCI) and did not include papers, theses, and books in the research. In addition, reviews, theoretical, design-based, and scale development studies were also not taken into consideration (Table 1). We used a boolean search string in the search; this technique uses keywords to select studies with high precision.

- Search terms:

  "gamification" OR "gamified" OR "gamifing" AND "education" OR "learning" AND "educational technologies" OR "instructional technologies"

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Published between January 2016 and December 2022	Papers, theses, and books
Published in Science Direct, Taylor & Francis Online, and Springer Link databases	Review and theoretical articles
Published in English	Design-based articles
Published in journals indexed by ESCI, SCI, SSCI	Scale development articles
Educational studies	Not educational studies
Educational/instructional technology studies	Not educational/instructional technology studies

We found 778 articles published between 2016 and 2022 as a result of our database search using the search terms mentioned above. Then, we excluded the studies that were not intended for use in education (f=317) and educwational technologies (f=39), reviews and theoretical studies (f=298), and studies conducted only for gamified environment design and/or model proposal (f=16) (Figure 2).

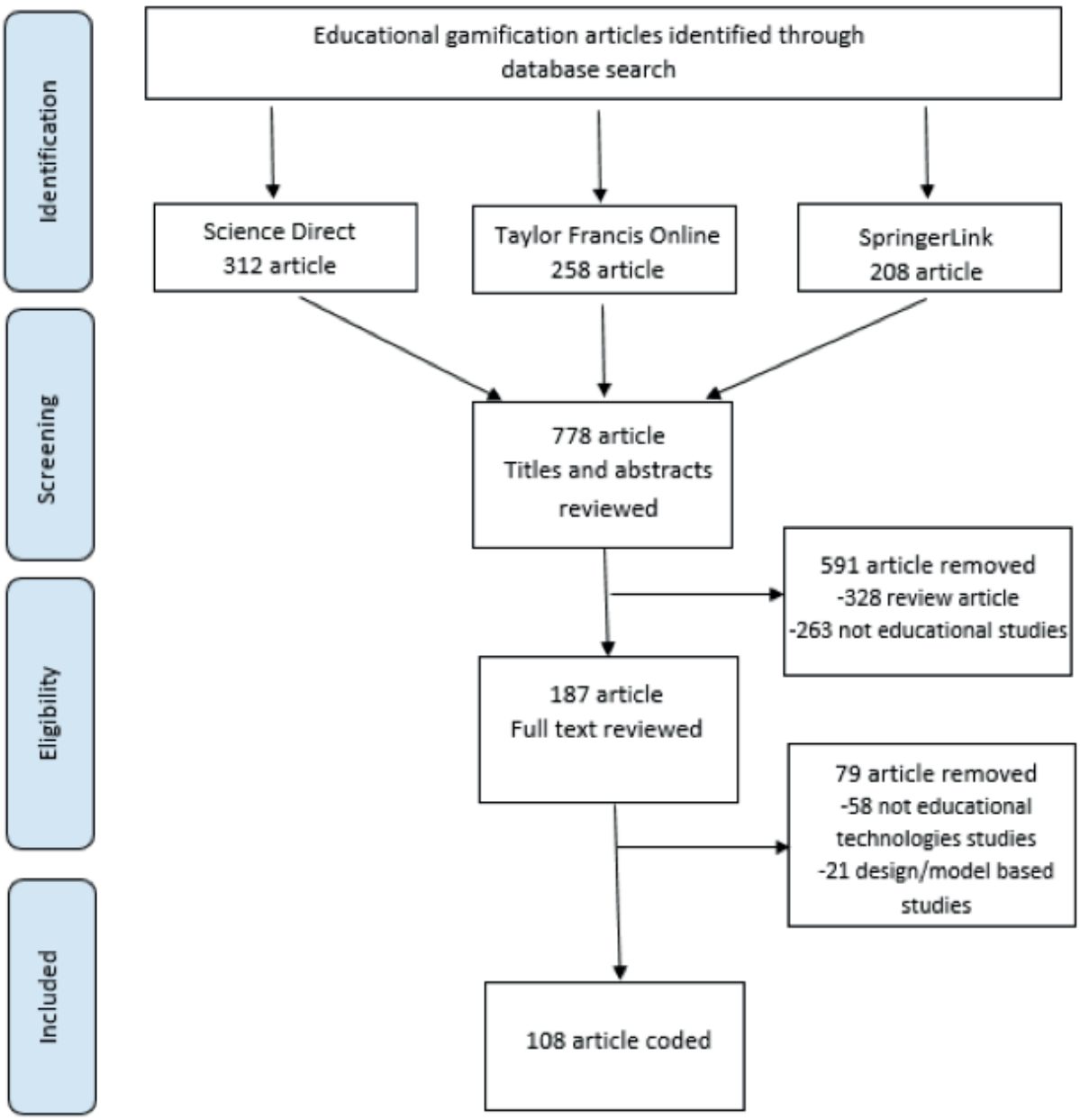

Figure 2. PRISMA flow diagram of the systematic review

Table 2. Reviewed articles

	Journal Name	Publication Year	Authors	f
Science Direct	Computers & Education	2016	de-Marcos et al. (2016) [1]	20
		2017	Albuquerque et al. (2017) [2], Buckley and Doyle (2017) [3], Ding et al. (2017) [4]	
		2018	Ding et al. (2018) [5], Garcia-Sanjuan et al. (2018) [6], Huang and Hev (2018) [7], Jagust et al. (2018) [8], Kyevski and Kramer (2018) [9], Tsay et al. (2018) [10], van Roy and Zaman (2018) [11], Zainuddin (2018) [12]	
		2019	Doumanis et al. (2019) [13], Orhan-Goksun and Gursoy (2019) [14], Park et al. (2019) [15]	
		2020	Chen et al. (2020) [16], Sanchez et al. (2020) [17], Zainuddin et al. (2020) [18]	
		2021	Bai et al. (2021) [19]	
		2022	Philpott and Son (2022) [20]	
	Computers in Human Behavior	2016	de-Marcos et al. (2016) [21], Tenorio et al. (2016) [22]	11
		2017	Cakiroglu et al. (2017) [23], Sailer et al. (2017) [24]	
		2018	Aldemir et al. (2018) [25]	
		2019	Ding (2019) [26], Groening and Binnewies (2019) [27], Lopez and Tucker (2019) [28]	
		2020	Putz et al. (2020) [29], Stoeffler et al. (2020) [30]	
		2021	Donnermann et al. (2021) [31]	
	International Journal of Human-Computer Studies	2019	Van Roy and Zaman (2019) [32]	5
		2020	Legaki et al. (2020) [33]	
		2021	Denden et al. (2021) [34], Lavoue et al. (2021) [35]	
		2022	Ulmer et al. (2022) [36]	
	Heliyon	2021	Jodoi et al. (2021) [37], Ruiz-Banuls et al. (2021) [38]	3
		2022	Alsadoon et al. (2022) [39]	
	Computers and Education: Artificial Intelligence	2021	Polito and Temperini (2021) [40], Tan and Cheah (2021) [41]	2
	Technological Forecasting & Social Change	2021	Legaki et al. (2021) [42]	2
		2022	Grijalvo et al. (2022) [43]	
	Entertainment Computing	2021	de la Pena et al. (2021) [44]	2
		2022	Dapica et al. (2022) [45]	
	Telematics and Informatics	2018	Ozdener (2018) [46]	1
	Health Professions Education	2019	Grangeia et al. (2019) [47]	1
	Journal of Hospitality, Leisure, Sport & Tourism Education	2021	Aguiar-Castillo et al. (2021) [48]	1
	Thinking Skills and Creativity	2021	Yildiz et al. (2021) [49]	1
	The International Journal of Management Education	2021	Kauppinen and Choudhary (2021) [50]	1
	Nurse Education Today	2022	Rosa-Castillo et al. (2022) [51]	1
	International Journal of Child-Computer Interaction	2022	Jogo et al. (2022) [52]	1

Taylor & Francis Online	Interactive Learning Environments	2016	Buckley and Doyle (2016) [53]	10
		2017	Hung (2017) [54]	
		2018	Lo and Hew (2018) [55], Zatarain Cabada et al. (2018) [56]	
		2019	Hassan et al. (2019) [57], Huang et al. (2019) [58]	
		2021	Bouchrika et al. (2021) [59], Recabarren et al. (2021) [60], Haruna et al. (2021) [61], Ramirez-Donoso et al. (2021) [62]	
	Computer Assisted Language Learning	2018	Rachels and Rockinson-Szapkiw (2018) [63]	6
		2020	Hong et al., (2020) [64]	
		2021	Eryigit et al. (2021) [65], Prados Sanchez et al. (2021) [66], Tao and Zou (2021) [67]	
		2022	Foroutan Far and Taghizadeh (2022) [68]	
	Innovation in Language Learning and Teaching	2018	Cruaud (2018) [69]	2
		2019	Ho (2019) [70]	
	Innovations in Education and Teaching International	2018	Wu (2018) [71]	2
		2020	Basal and Kaynak (2020) [72]	
	Environmental Education Research	2021	Leitão et al. (2021) [73]	2
		2022	Cook et al. (2022) [74]	
	Journal of Education for Business	2018	Chapman and Rich (2018) [75]	1
	Distance Education	2019	Huang et al. (2019) [76]	1
	Research in Science & Technological Education	2021	Wommer et al. (2021) [77]	1
	Technology, Pedagogy and Education	2021	Erumit and Yilmaz (2021) [78]	1
	Educational Action Research	2021	Kulhanek et al. (2021) [79]	1
	Journal of Criminal Justice Education	2022	Gehring and Marshall (2022) [80]	1
	Music Education Research	2022	Carrion Candel and Colmenero (2022) [81]	1
	Physical Education and Sport Pedagogy	2022	Sotos-Martinez et al. (2022) [82]	1
SpringerLink	Education and Information Technologies	2021	Pakinee and Puritat (2021) [83],	4
			Areed et al. (2021) [84]	
		2022	Leitão et al. (2022) [85], Balci et al. (2022) [86]	
	TechTrends	2016	Kopcha et al. (2016) [87]	4
		2020	Uz Bilgin and Gul (2020) [88]	
		2021	Nair and Mathew (2021) [89]	
		2022	Coffland and Huff (2022) [90]	
	BMC Medical Education	2020	Seidlein et al. (2020) [91]	3
		2021	Dugnol-Menendez et al. (2021) [92]	
		2022	Valenzuela-Pascual et al. (2022) [93]	
	Smart Learning Environments	2020	Smiderle et al. (2020) [94]	3
		2022	Oliveira et al. (2022) [95], Celik and Yangin-Ersanli (2022) [96]	
	Journal of Computing in Higher Education	2020	de la Pena Esteban et al. (2020) [97],	2
			An et al. (2020) [98]	
	Journal of Formative Design in Learning	2017	Kenny et al. (2017) [99]	1
	Technology Knowledge and Learning	2017	Millis et al. (2017) [100]	1
	Journal of Computers in Education	2020	Zou (2020) [101]	1
	International Journal of Technology and Design Education	2020	Fernandez-Antolin et al. (2020) [102]	1
	Multimedia Tools and Applications	2021	Molero et al. (2021) [103]	1
	International Journal of Educational Technology in Higher Education	2021	MurilloZamorano et al. (2021) [104]	1
	Behavior Analysis in Practice	2021	Parry-Cruwys and MacDonald (2021) [105]	1
	Journal of Computing in Higher Education	2021	Zahedi et al. (2021) [106]	1
	Educational Technology Research and Development	2021	Zhao et al. (2021) [107]	1
	Medical Science Educator	2022	Walker et al. (2022) [108]	1
			Total	108

Based on our research goals, we analyzed a total of 108 articles: 53 from Science Direct, 29 from Taylor & Francis Online, and 26 from SpringerLink. Five of these articles were published in 2016, eight in 2017, 16 in 2018, 13 in 2019, 15 in 2020, 32 in 2021, and 19 in 2022 (Table 2). The articles analyzed in this study were published in the leading journals of the field and came from 32 different countries (Ireland, USA, Spain, Turkiye, Germany, Brazil, UK, China, Japan, South Korea, Belgium, Taiwan, New Zealand, Norway, Mexico, Pakistan, India, Egypt, Iran, Thailand, Tunisia, Estonia, Australia, France, Singapore, Algeria, Saudi Arabia, Greece, Italy, Chile, Portugal, Tanzania), across three different databases. Thus, it can be said that this set of articles is strong enough to provide valid generalizations of gamification in educational fields and in different nations (Zauniddin et al., 2020).

FINDINGS

Gamification Definitions and Features Used in Definitions

When we examined the articles in the research, we found that game-based learning was defined in order to explain gamification first, and the distinction between these two terms was pointed out. In addition, studies have emphasized that there is a transition from game-based learning to gamification. In addition, studies have emphasized that there is a transition from game-based learning to gamification. Most of the definitions used in the articles emphasize the use of game elements in non-game contexts and include features such as motivation, facilitating learning, problem solving, and active participation. Although it is stated extensively in the literature that gamification is a fun learning environment and that motivation can increase with competition among students, it is a remarkable finding that this feature does not take much place in the definitions. In addition, while gamification is defined as a method, technique, or strategy in some articles, it is also defined as an educational approach and a teaching tool in other articles.

Theoretical Framework of the Articles

In this review, we analyzed the theories and models that are most associated with gamification design in the articles and are based on the formulation of research questions. We saw that Self-Determination Theory was the most frequently used in the articles, followed by Flow Theory, and Werbach and Hunter's Model, and the theories and models used mostly showed gamification design and were motivation-oriented. In addition, it is noteworthy that 61% of the articles do not use any theory or model. This situation reveals that there is a theoretically important gap in the studies in the field of gamification.

Research Method and Participants

In this study, we examined the research method, model, and data collection techniques of the articles in line with the second research question. We found that the studies were mostly conducted as quantitative research (66%, *f*=71). While the mixed research method was used in 30% of the studies (*f*=32); the qualitative research method, on the other hand, had a usage rate of only 4% (*f*=4). This evidence reveals that more qualitative studies are needed in the field of gamification in education. In addition, 64% (*f*=67) of quantitative and mixed studies were conducted as experimental studies, and research data were collected using questionnaires and scales in 50% (*f*=56) and achievement tests in 23% (*f*=26). Participants were interviewed in all mixed and qualitative studies, and observation forms were also used in 5% of these studies (*f*=2). Other techniques used in research were evaluation forms, system data, and social network analysis.

According to our analysis, the majority of the studies were conducted with undergraduate-level participants (58%, *f*=63). In addition, we found that 9% (*f*=10) of the studies were carried out at the postgraduate level, 8% (*f*=9) at the primary school level, 9% (*f*=10) at the secondary school level, 4% (*f*=4) at the high school level, and 4% (*f*=5) in adult education. Only one study was conducted at the preschool level. It is one of the important findings of this study that few studies have been implemented at the preschool, primary, and secondary school levels, which are thought to have high interest and motivation towards gamification elements (Haruna et al., 2021; Jogo et al., 2022; Oliveira et al., 2022). Since academicians have easy access and practice opportunities, they may have chosen the participants mostly from the undergraduate level.

Gamified Learning Environment

Game elements can be used in many learning environments. Therefore, we also analyzed the gamified learning environments in the articles (Table 3). As a result, e-learning came to the fore in gamified learning environments. Mobile learning and flipped classrooms followed with 32% each. Additionally, the use of gamification in collaborative learning, blended learning, and virtual reality and augmented reality learning environments draws attention.

Table 3. Gamified learning environment and method

Learning Environment/Method	f	%
E-Learning	73	67
Mobile Learning	22	20
Flipped Learning	12	12
Virtual Reality and Augmented Reality	7	6
Blended Learning	6	5
Collaborative Learning	5	5
Social Network-Supported Learning	3	3
Smart Tutoring Systems	2	2
Artificial intelligence/Robotics	2	2
Simulation	2	2
7E Model	1	1
Deep Learning	1	1
Active Learning	1	1

Game Elements

In our study, we examined the game elements used in gamified learning environments. We have found the most commonly used game elements in the research to be; score, leaderboard, badge, level, team/group/collaboration, feedback, mission/challenge, reward, and social interaction, respectively. In addition, competition, clues, and peer assessment were seen to be used less frequently (Table 4). In a few studies (*f*=7), the score is reduced and reflected in the total score as a result of the user's mistake or wrong answer. In addition, a time limit is applied in 22% of the studies using the scoring system, and in 6% of the studies, hints are given when the user gives an incorrect answer or upon the user's request. In the use of badges, both the badges given automatically by the system and the badges sent by the instructor were used. Progressive challenges, another game element that has a high usage rate in research, are included as locked content in 30% of these researches. Thus, it is not possible to move on to the next level without completing a level. For social interaction, online discussion groups and forums were used in 64% (*f*=20) of the studies, blogging in 19% (*f*=6) and social media environments in 16% (*f*=5). In gamified learning systems; profiles created by students include nicknames, profile pictures, scores, badges, and rewards. In 15% (*f*=5) of the studies in which this system is used, these profile features can be purchased with earned points or badges.

Table 4. Game elements used

Game Elements	f	%	Game Elements	f	%
Points/Score	95	81	Progress bar	22	19
Leaderboard	69	59	Time limit	21	18
Badge	62	53	Freedom of choice	16	14
Level	56	48	Locked content	15	13
Task/Mission/Challenge	54	46	Meaningful story	13	11
Feedback	48	41	Instructions/Lesson map	9	8
Team/Group/Collaboration	47	40	Competition	8	7
Reward	42	36	Clue	6	5
Social interaction	31	26	Peer assessment	2	2
Avatar/Profile/Nickname	31	26			

Investigated Variables

Many variables have been investigated in studies conducted in gamified learning environments. We categorized these variables under three main groups in line with our analysis: pedagogical, gamification, and personal (Table 5). We also explained the pedagogical variables in three dimensions (cognitive, affective/emotional and behavioral) based on the model proposed by Fredricks et al. (2004).

Table 5. Investigated variables

Pedagogical	Gamification	Personal
Cognitive Dimension Affective/Emotional Dimension Behavioural Dimension	Game Elements Type of Player	Personal Characteristics

One of the primary dimensions, namely the behavioral dimension, refers to the mix of behaviors of a student who is interested in learning and succeeding in academic areas such as class attendance, active classroom participation, participating in group work, and completing individual tasks on time. A second, namely cognitive dimension, refers to students' thoughts, beliefs, and perceptions about the importance of academic work and the effort this requires, along with the cognitive and metacognitive strategies the student would need to use to achieve significant learning. The third is an affective, or emotional dimension, which includes the student's positive and negative feelings and attitudes towards the educational institution and learning experiences.

Table 6. Variables investigated in articles

	Variables	f	%
Pedagogical	*Cognitive Dimension*	*79*	*73*
	Performance/academic achievement	60	55
	Learning Experience	12	11
	Problem Solving Skill	2	2
	Critical Thinking	2	2
	Learning styles	2	2
	Cognitive load	1	1
	Affective/Emotional Dimension	*70*	*64*
	Motivation	39	36
	Satisfaction	11	10
	Attitude	6	5
	Perception	5	5
	Self-efficacy	3	3
	Anxiety	3	3
	Interest	3	3
	Behavioral Dimension	*37*	*34*
	Engagement	32	30
	Class dynamics/Social relationship/Group cohesion	3	3
	Course/exam completion rate	2	2
Gamification	Game Elements	7	6
	Type of player	1	1
Personal	Personal characteristics	7	6

Results Regarding the Variables Investigated in the Articles

Pedagogical Variables

Results on the Cognitive Dimension

In the articles examined, cognitive skills such as performance, academic achievement, learning experience, problem solving skills, cognitive load, and learning styles of students in gamified learning environments were studied. 78% (*f*=47) of the studies investigating academic achievement and performance reported that gamification improved academic achievement and performance [1, 2, 3, 7, 8, 10, 12, 15, 17, 18, 21, 22, 23, 26, 27, 29, 33, 36, 38, 43, 44, 46, 47, 52, 53, 54, 55, 56, 58, 60, 61, 70, 71, 73, 76, 77, 84, 88, 89, 91, 94, 96, 97, 105, 106, 107, 108], while 19% (*f*=12) reported that it did not make a significant difference [6, 14, 16, 39, 50, 63, 75, 85, 88, 96, 104, 108]. An experimental study [20] revealed that performance decreased in a gamified learning environment. In this study, it was also stated that as a result of the decrease in the intrinsic motivation of the students over time, their performance may have been negatively affected. In addition, in a study [1], it was concluded that the students in the experimental group participating in the gamification activities carried out with social network support had higher achievement than the students in the experimental group participating in the classroom gamification activities. In a study [17] that found that gamification had a positive effect on performance, the novelty effect was looked into and as a result of the research, it was concluded that performance first increased with the novelty effect, but then decreased. However, in another study [59], it was determined that there was no novelty effect and that the increase in performance continued during vacation and after graduation. Looking at this variety of results, we can say that more studies should be conducted to look into the novelty effect, and these results should be further discussed.

Studies have shown that as a result of gamification activities, students' problem solving skills [30, 97], cognitive effort [15] and the rate of completing the activities on time [76] have increased. As a result of the interviews with the students in these studies, it was found that a dynamic environment was created by the

use of feedback and that this in turn had a positive effect on the results. Moreover, it was emphasized that the task, the required effort, and the time should be managed together. In 13% (*f*=8) of studies investigating academic achievement and performance, students' personality traits [2, 10, 33, 106], player type [28] and the effect of game elements used [8, 19, 73] were examined, and it was seen that these independent variables affected the results. In a study in which learning styles were examined [3], it was revealed that active students had a more positive perception of gamification and individuals with global learning styles performed better in gamified learning activities.

Results on the Affective/Emotional Dimension

In the articles studied, affective skills such as students' motivation, interest, attitude, self-efficacy perception, and anxiety levels were also investigated. In 84% (*f*=33) of the studies examining the motivation of students, it was found that the motivation of the students in the experimental group participating in gamified learning activities was higher than that of those in the control group, and as a result of the questionnaires and tests, it was revealed that the motivation increased with the gamified learning activities [4, 12, 19, 20, 27, 35, 36, 38, 39, 40, 41, 48, 49, 53, 57, 62, 67, 70, 75, 77, 78, 79, 82, 83, 85, 89, 93, 97, 99, 100, 102, 103, 107]. However, in these studies, the importance of careful design of the gamified system was emphasized. It was stated that positive and negative feedback should be well balanced in order not to damage the participants' sense of competence or increase the pressure too much. In 10% (*f*=4) of the studies, it was found that gamified learning activities did not make a significant difference on motivation [31, 60, 86, 92]. In addition, 5% of the studies (*f*=2) stated that motivation actually decreased, whereas in one of these studies [11], it was concluded that motivation decreased initially but then increased, while another research [9] found that extrinsic motivation increased but intrinsic motivation decreased. In these studies, it has been seen that the badges that the students can see themselves show more positive results than the badges that others see. According to the results, while achievement, progressing to the next level, being in the first place on the leaderboard, and the desire to win awards, points, or badges affect motivation positively, in some cases, easily moving to the next level and the complacency brought by achievement can negatively affect motivation. In addition, it was seen that motivation decreased in cases of failing tasks, not being able to move on to the next task or level, not earning a badge, and falling behind the class on the leaderboard. In the studies, it was stated that the difficulty level of the tasks should be appropriate, the students should be supported with feedback and clues when needed, and the leaderboard should be arranged in a way to ensure the continuity of motivation with some rules (e.g., tasks to be completed and badges to be obtained to stay ranked).

In studies, it was concluded that gamification activities increased students' interest [43, 98, 100]. Only one study showed no significant difference [94]. Three studies investigated how gamification affects students' self-efficacy perceptions. While improvement in the perception of self-efficacy was found in two studies [98, 106], no significant difference was observed in the other [63]. In addition, it was observed that the anxiety level of students decreased after participating in gamified activities [2, 64, 90].

Results on the Behavioral Dimension

Students' participation in gamified learning environments, online discussions, competitions, formative assessment activities, and e-learning systems, as well as their acceptance of these systems, course completion rates, and social interaction were investigated in this aspect. In 87% (*f*=26) of the studies examining engagement, it was found that gamified learning environments increased student engagement [4, 5, 7, 10, 14, 15, 18, 19, 22, 23, 26, 35, 40, 43, 44, 47, 50, 52, 55, 59, 65, 78, 80, 83, 94, 108], whereas 6% (*f*=2) of the studies found a decrease [31, 46], and 6% (*f*=2) did not show a significant difference [92, 106]. In addition, in a study [53] it was found that engagement varied according to intrinsic and extrinsic motivation. In this paper, it was concluded that while the student's engagement increased in the activities supporting intrinsic motivation, it decreased in the activities supporting extrinsic motivation. A study investigating the novelty effect on student engagement [57] revealed that there was no novelty effect on the increase in engagement, and that there were students who always used the platform, even during vacation or after graduation.

In the interviews, the students said that they found the learning environment fun, motivating, and interesting, and that the activities aroused a sense of curiosity. Furthermore, the reasons for the decrease in participation were revealed through interviews with students as follows:

- Satisfaction and complacency as a result of the success achieved and being at the top of the leaderboard.
- Lack of motivation: failing missions, failing to advance to the next mission or level, failing to earn badges, and lagging behind the class on the leaderboard.

Certain suggestions have been made in the examined studies regarding the negative situations mentioned above: Tasks and difficulty levels should be determined according to the readiness of students; the levels should gradually get more difficult as they progress; students' curiosity should be strengthened with locked contents; and freedom of choice in tasks and goals should be provided. In the studies, it has been emphasized that such measures to be taken in gamified learning environments can increase the engagement of students by providing both internal and external motivation. In a study that dealt with a system that was constantly updated based on student feedback [78], it was seen that the students in the top three on the leaderboard would be removed from the leaderboard if they did not receive a badge in the next task, and it was concluded that engagement was increased by preventing the sluggishness that occurred.

In a study [57] conducted at a school with a high dropout rate, course completion rates were examined, and it was concluded that the rate of dropping out of school decreased after the implementation of gamified learning activities. Similarly, in another study [79], it was seen that the rate of completing the activities was higher in the experimental group participating in gamified learning activities.

In all of the studies investigating social interaction and classroom atmosphere [16, 70, 88], it was observed that social interaction and group cohesion were high and a positive classroom atmosphere was formed through gamification activities. Moreover, it was also noted that gamification activities improve the sense of community. However, despite the results revealed in these studies, contrary student opinions were also found. Some students stated they did not like being on a team or working in a group, or that they were not satisfied with their teammates. The different personality traits and learning styles of the students may have played a role in these outcomes. In a study investigating social interaction [24], the effect of game elements on interaction was analyzed. It was observed that social interaction was higher in activities with avatars, meaningful stories, and team-play game elements compared to activities using badges, leaderboards, and performance graphics. In addition, one of the results was that competition negatively affected social relations.

Gamification Variables

Results on Player Types

We reviewed a study based on player types [28] in which the Hexad player types (achievers, free spirits, philanthropists, disruptors, players, socializers) were employed (Marczewski, 2015). According to the results, students' performance, motivation, approaches to game elements, and activity choices differed according to player types. Therefore, it was emphasized that player types should be considered in gamification design while including game elements in learning environments.

Results on Game Elements

As a result of the analysis of gamification elements, it was revealed that badges have a positive effect on learning outcomes [24, 25, 73, 85]. When the students discovered the leaderboard, some enthusiasm was observed in their behavior, and among all the game elements, this was the one for which the students showed the most excitement. However, negative results were also obtained from learning outcomes in practice in which this element played an active role [20, 73, 85]. Studies have shown that this element mostly focuses on extrinsic motivation, and therefore the rate of attendance and learning performance are negatively affected [41, 85]. It was observed that students in the top three on the leaderboard had a feeling of complacency, and therefore there was a problem ensuring the continuity of achievement. On the other hand, it was seen that the students in the lower ranks had a feeling of failure, and for this reason, their motivation was negatively affected [19]. However, these results differ between the studies examined in the study. As a matter of fact, in a study in which game elements were examined in detail [8], participants stated that a competitive environment was created with a challenge and leaderboard, and thus they were motivated to participate in both classroom

and online activities. They also stated that difficulties in tasks and levels are required for the continuity of motivation. Students said that the awards increase their participation in online and classroom activities, the supportive messages on the badges increase their self-confidence, and they basically evaluate themselves with the feedback badges that track their progress [25]. In addition, while the participants expressed that they enjoyed working in teams, they also criticized their teams for a number of reasons (teammates, community building). Finally, it was concluded that the social relations levels of the students in the activities with game elements such as avatars, team plays, and meaningful stories were higher compared to the activities in which other game elements were used [24].

Personal Variables

Results on Personal Characteristics

In studies on the effects of personal characteristics; it was observed that traits such as extraversion, conscientiousness, determination, and responsibility had an effect on individuals' gamification perceptions and performances [3, 34, 95]. In studies conducted by gender [2, 10, 34, 61, 95, 106], it has been stated that gender can have an effective effect on individuals' perceptions of game elements. In addition, it was also revealed that gender had an effect on students' engagement in the gamified learning environment. In these studies, it was concluded that the effects of game elements are highly personal and may vary greatly between different students.

DISCUSSIONS AND CONCLUSION

Examining the data reveals that there is a misunderstanding between the terms "gamification" and "game-based learning." Actually, there's a considerable distinction between gamification and game-based learning. While game-based learning aims to provide education through games, gamification does not take on the role of learning. Rather, it emphasizes conducting an entertaining learning process with game elements, increasing student motivation and participation, and overcoming obstacles that arise from time to time. In most of the studies examined, the researchers emphasized the use of game elements in non-game contexts and included features such as motivation, facilitating learning, problem solving, and active participation in their definitions. As a result, when we consider the common features of the definitions, we can define it as the use of fun game elements in non-game contexts that enables students to be active in order to increase learning motivation, student participation, and student performance.

In the articles we examined for our study, Self-Determination Theory was the most frequently used; followed by Flow Theory and Werbach and Hunter's Model. On the other hand, the results of this study showed that no model or theory was used in 61% of the studies. This finding reveals that the theoretical framework of the studies in the field is not based on a strong foundation. Studies in the literature have indicated that the theory has not been empirically examined and applied, as most studies do not refer to any theory, and this creates an important gap that limits the growth of the field as a whole (Huang et al., 2019; Krath et al., 2021; Nacke & Deterding, 2017; Seaborn & Fels, 2015; Zainuddin et al., 2020). In their literature analysis on gamification in education, Zainuddin et al. (2020), Kalogiannakis et al. (2021), and Nadi-Ravandi and Batooli (2022) found that the majority of the studies lacked a theoretical foundation. The findings of this research indicate that the studies primarily relied on theories and models for the development of gamified learning environments. As Sen (2019) stated in his study, motivation and design-based theories have been used more heavily in recent years. However, Park et al. (2019) and Sanchez et al. (2020) emphasized that the theory-based design of gamified learning systems is not given enough attention. Similarly, according to the results of this study, the same problem regarding the theoretical background continues to a large extent in recent studies as well. In future studies, it is important for researchers to consider theory and/or models when designing gamified learning environments. Thus, stronger, more robust, and reproducible results would be obtained. Future research on gamification in education should prioritize the development and utilization of theories and models for the gamification of the learning environment. This requires doing additional investigations, as suggested by Nadi-Ravandi and Batooli (2022) and Zainuddin et al. (2020). Furthermore, it is crucial to highlight the significance of these theories and models, and to thoroughly

analyze their practical implementations within the framework of instructional design models, social learning theories, cognitive and behavioral theories, motivation models, and psychological theories (Nadi-Ravandi and Batooli, 2022). Therefore, in order to create a gamified learning environment that is well-structured, efficient, and beneficial, it is important to consider the psychological and social demands, as well as the personality traits, of the students. Furthermore, conducting an analysis of the social, cognitive, affective, and behavioral impacts of the activities conducted in these learning settings on students can provide study findings that are grounded in robust principles.

When we examine the research methods used in the articles, we see that the research was mostly conducted as quantitative studies, while the qualitative research method was very rarely used. In addition, quantitative studies were carried out mostly as an experimental study. Experimental studies have revealed the potential of gamified learning environments to provide performance, motivation, and student engagement. However, in-depth research that takes into account the gamification elements and individual differences used in studies conducted in various learning environments is still required. At this point, the existing literature shows that gamification, when well designed and used correctly, has the potential to improve learning, but qualitative research is needed to reveal how various game elements should be applied to different learning contexts (Aldemir et al., 2018). Therefore, for the purpose of averting this shortcoming, the gaps that cannot be bridged with quantitative data could as well be eliminated by bringing into play the strengths provided by the use of qualitative data. Subsequent qualitative research may uncover the subjective anticipations, inclinations, encounters, comprehensions, and reflections of students in gamified educational settings from a more comprehensive standpoint (Cook et al., 2022; Licorish et al., 2018; Zou, 2020). Therefore, it is potentially can be feasible to customize the gamified setting by integrating personal attributes, various game components, levels of difficulty, and helpful suggestions. Mixed-methods research yields more thorough and holistic findings within the subject area. Ingleton and Davies (2007) argue that integrating qualitative and quantitative methodologies in a single study enhances the comprehension of different facets of the phenomenon being examined, leading to a more comprehensive knowledge and the development of more well-informed educational policy. Utilizing mixed-methods research in gamification will enhance comprehensiveness by combining quantitative data with the underlying rationales, factors, and reflections influenced by personal experiences. This will provide indicators for assessing the efficacy of gamified learning settings. Consequently, it will offer a diverse array of comprehensive material for educators and instructional designers.

The majority of the studies were conducted in undergraduate educational settings. It is noteworthy that very few studies have been conducted at the pre-school, primary, secondary, and high school levels. It is thought that especially pre-school and primary school students can adapt more to a fun learning environment gamified with game elements, thus increasing their interest and motivation towards learning and providing more effective and permanent learning (Jogo et al., 2022; Kucuk & Sisman, 2017; Wommer et al., 2021). For this reason, further studies at these grade levels and testing these hypotheses will contribute to the field. Researching gamification across diverse educational levels, disciplines, and cultural backgrounds will yield comprehensive insights into its contextual effectiveness. Toda et al. (2020) highlight the scarcity of research on gamification that examines cultural influences. The researchers put forward and assess a model called the Gamification Model for Cultural Studies (GamiCSM) in order to gain a deeper understanding of how cultural aspects and gamification are interconnected in educational contexts.

E-learning environments stand out among the gamified platforms in the studies. The studies conducted in these learning environments investigated variables such as performance, motivation, engagement, completion of performance activities, and dropout rates. According to the results, gamified learning activities increased motivation, performance, and engagement, as well as activity and course completion rates and in addition to decreasing dropout rates. Furthermore, it was concluded that student engagement varied depending on motivation. Particularly, it was observed that participation was higher in activities that provided intrinsic motivation (Buckley & Doyle, 2016). These findings are significant in light of issues in distance education systems such as low participation, failure to complete activities, and dropping out (Behl et al., 2022; Bilgic & Tuzun, 2015; Freitas & Silva, 2020; Guohong et al., 2012; Khaldi et al., 2023).

Literature review also showed that in distance education environments, limited student-student and student-teacher interaction, insufficient feedback, and failure to provide students with the autonomy and flexibility they want can lead to a decrease in students' interest and motivation, and therefore, high participation

cannot be achieved (Celen et al., 2011; de la Pena et al., 2021; Guohong et al., 2012; Khaldi et al., 2023). In addition, the use of game elements that are fun, interesting, motivating, and interactive has been suggested to solve these problems (Amriani et al., 2013; An et al., 2020; Caglar & Kocadere, 2015; de la Pena et al., 2021; Freitas & Silva, 2020; Ozcinar et al., 2021; Sahin et al., 2017). According to Jayalath and Esichaikul (2022), a gamification approach can provide significant benefits by solving the problems of motivation and participation, as well as eliminating student dissatisfaction and boredom, and thus can offer a solution to the problem of high school dropout rates. Similarly, in the study An et al. (2020) conducted with trainers on gamification in MOOCs, most participants expressed interest in gamification and stated that they would prefer to use game elements in their future MOOCs. Interestingly, they also stated that they mostly wanted to gamify their MOOCs to reinforce students' social interactions and retention. In their study, de la Pena et al. (2021) designed a gamification model for university-level distance education and analyzed its results. According to the results, the interaction of the students in the classroom increased, the number of students taking the exam and passing the course increased, and learning improved. Thus, in line with the studies in the literature and the findings of this research, it is revealed that gamified learning environments can be used as an alternative to solve the problems mentioned in distance education. Due to the health measures taken during the COVID-19 epidemic, face-to-face education could not take place, and education activities were carried out using distance education systems (Dennon, 2021). For this reason, the primary concern of educators who use technology as a motivation tool has become the lack of education methods. The difficulties of online education, such as staying motivated, engaging with course content, and participating in classroom activities, have become more pronounced due to social isolation (Nair, 2021; Zainuddin et al., 2021). Gamification, which is proposed as a solution to overcome these difficulties, has gained importance in the distance education process as it helps students internalize the learning content and enrich their learning experiences (Areed et al., 2021; Balci et al., 2022). In this study, it is a remarkable result that the rate of articles published in 2020 and 2021, when the COVID-19 pandemic process was experienced, was 43% (f=47) and 53% (f=25) of these articles were conducted in distance education systems. According to Alzahrani and Alhalafawy (2022), the move to e-learning platforms during the COVID-19 pandemic has increased interest in gamification. Gamification helps students achieve educational goals, assesses their strengths and weaknesses, improves learning, and motivates them to learn, according to their literature review. However, managing a virtual classroom, implementing gamification that doesn't match learners' sensory preferences, boredom from repetitive activities, task complexity, time constraints, negative emotions like anxiety, frustration, and worry, and a lack of internet connectivity are challenges. Phung (2020) found that gamification can cause student boredom, low self-confidence, tension, helplessness, discomfort, hesitation, diversion, and a desire to stop. While not expressly highlighted in the studies, these negative characteristics raise ethical problems such as system manipulation, dishonesty, unhealthy competition, depression, and privacy invasion (Almeida et al., 2023). Potential avenues for future research could involve creating ethical standards for gamification in education.

In the articles we reviewed, we saw that gamified learning environments positively affected students' participation, interest, motivation, and performance. However, the results obtained in studies on gamification differ. Studies have found positive (Dahalan et al., 2023; Dehghanzadeh et al., 2019; Ekici; 2021; Erumit & Yilmaz, 2021; Freitas & Silva, 2020; Hung, 2017; Jayalath & Esichaikul, 2022; Su & Cheng, 2015; Zainuddin et al., 2020) and negative effects (Almeida et al., 2023; Kyewski & Kramer, 2018; Philpott & Son, 2022; Phung, 2020; Van Roy & Zaman, 2019; Tan & Cheah, 2021; Toda et al., 2018) for motivation, performance, retention, or user effectiveness. On the other hand, some studies did not reveal any effect restricted to certain conditions (Attali & Arieli-Attali, 2015; Balci et al., 2022; de Marcos et al., 2014; Hanus & Fox, 2015; Koivisto & Hamari, 2014; Mese & Dursun, 2019). According to de la Pena et al. (2021), gamification is not a guarantee of success because how it is implemented will determine dropout rates and interaction levels. Similarly, Hamari et al. (2014) stated in their literature review that gamification provides an effective learning environment, but there are points to be considered. Leitao et al. (2022), emphasizing that there is no one-size-fits-all model for successful gamification of a learning activity, attributed the mixed findings of the gamification literature to the different designs of applied game design elements and gamification systems.

Use of various items (e.g., leaderboards, charts, narratives, badges), amount of items used (e.g., amount of achievements), visual presentation (e.g., animations, appeal), difficulty (e.g., easy achievements), and

duration of use (e.g., single task, long-term use) are considered important in the gamification process (Groening & Binnewies, 2019). Hamari et al. (2014) mentioned that in most of the studies, the context and the characteristics of the participants came to the fore. Van Roy and Zaman (2018) stated that the effects of game elements are highly personal and may show many differences among different students. In gamified systems, recent research has shown that customizing gamification (according to different aspects such as gender, user type, and pedagogical tasks) can affect users' experiences (positively or negatively) (Denden et al., 2022; Hallifax et al., 2019; Klock et al., 2020; Oliveira et al., 2022; Rodrigues et al., 2020, Tan et al., 2023). In addition, Ding (2019) stated that the effect of the gamification approach on performance may depend on the game elements used. Leitao et al. (2022) discovered that each distinct game element possesses varying levels of potential to enhance motivation. Likewise, Leitao et al. (2021) made a systematic evaluation of each item and observed that the effects of different game features on the learning experience and learning outcomes of the participants varied. Tan and Cheah (2021) concluded that feedback encourages students to stick to the course and continue; rewards further increase the motivation to be successful in practice; on the other hand, a leaderboard negatively affects motivation by increasing stress. They also stated that students' use of usernames instead of names could be beneficial for the negative consequences caused by the leaderboard. Similarly, Mese and Dursun (2019) concluded in their study that the experience score in terms of leaderboard, competitive environment, and level negatively affects motivation. They also observed that there was a decrease in motivation when tasks were not completed and badges were not earned. Kyewski and Kramer (2018) concluded that badges have less impact on motivation and performance than is generally assumed and that students' intrinsic motivation decreases over time. In addition, they determined that badges that can be seen by the students themselves produce more positive results than those that can be seen by others. Almeida et al. (2023) conduct a literature review to establish the connections between game design features and the adverse consequences they can generate. The research findings indicate that the commonly reported negative effects in the studies include lack of influence, deteriorating performance, motivational issues, lack of comprehension, and apathy. Furthermore, game design elements such as badges, leaderboards, competitions, and points were identified as the primary factors contributing to these negative effects. These findings offer insights for educators and instructional designers on how to effectively manage the advantages and disadvantages of the gamification features they employ.

In the study conducted by Denden et al. (2021), the results showed that gender and personality can influence students' perceptions of game elements. Similarly, Smiderle (2020) investigated the effects of gamification on students' learning, behavior, and participation based on their personality traits in a web-based learning environment, and they found that the effect of gamification depends on the specific characteristics of the users. Such that, in their systematic review study, Khaldi et al.'s (2023) classification of gamification approaches reveals the tendency towards personalization in gamification. Hamari et al. (2018) stated that gamification features may be perceived as more important by users who have easier goals, are result-oriented, and are more likely to prove themselves to others. Zahedi et al. (2021) argued that while implementing gamification elements into a learning environment, it is very important to adapt player types to gamification settings, and this issue should be carefully considered based on theories. Buil et al. (2020) present empirical evidence based on Self Determination Theory that uses various game design elements to motivate students and meet their needs for competence, autonomy, and relatedness. This study provides information that lays the groundwork for future research. Denden et al. (2022) pointed out that learners' personality traits and player types should be considered in gamification studies. For this reason, it is very important to consider students' personality traits and learning styles, the gamified learning environment and game elements used, and environmental factors in future research. Thus, deeper and more comprehensive inferences can be made from the obtained results.

Consequently, the implementation of gamification in education and learning enables educators to create an enjoyable learning experience, enabling students to promptly understand learning objectives and actively engage with the social learning environment. Nevertheless, if gamification is not adequately strategized and tailored to user requirements, the outcomes may fall short of expectations, and there is even a possibility of negative repercussions. By designing the gamification environment and doing research on its effectiveness using theories like self-determination theory, flow theory, gamification design models, and learning theories, we may obtain robust and impactful outcomes. The results can offer educators and instructional designers

in-depth insights into how to incorporate gamification into the learning environment using a theoretical framework. Therefore, they have the ability to establish a learning environment that incorporates game elements, which is both efficient and delivers desired outcomes. Providing a gamified learning environment that allows for personalization based on students' individual characteristics, preferences, interests, readiness levels, and perception styles can potentially maintain high levels of student motivation and ensure completion of activities. Furthermore, a thorough assessment of the game features to be incorporated into the system and the extent to which students will be exposed to these aspects can play a crucial role in evaluating the efficacy of gamification. This study indicates that the utilization of various game elements has distinct impacts on study outcomes. By including well-designed gamified learning settings that cater to both individual and social needs, while considering the aforementioned criteria, it is possible to effectively address issues commonly encountered in distant education platforms, such as lack of motivation, boredom, and student attrition. In this study, we examined the research on gamification in education by limiting it to ESCI, SCI, and SSCI-indexed articles published in Science Direct, Taylor Francis Online, and Springer Link databases. Future literature reviews can explore gamification studies in education more broadly by examining articles published in other databases and journals, theses, and papers. Additionally, by focusing on research on gamified learning environment design, it can provide detailed information on how to apply design principles more effectively and how to integrate game elements into the system and curriculum. One of the remarkable results of the research is that gamification can be an effective method to solve problems such as lack of motivation, boredom, and dropping out of the course in distance education. In this regard, potential opportunities and risks can be discussed by examining studies specifically on gamification on distance education platforms.

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MULTISTAKEHOLDERS GOVERNANCE FRAMEWORK FOR ONLINE LEARNING MARKETPLACE CONSORTIUM: POWER DYNAMIC PERSPECTIVE

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ABSTRACT

This paper proposes a governance model framework for online learning marketplaces in Indonesia. This research uses a case study approach to explore a model that is adequate and suitable to be applied in the context of the Indonesia Cyber Education Institute, which was initiated by Universitas Terbuka, Indonesia. The proposed model was prepared after conducting a literature study, which was validated by expert and stakeholder opinions in a forum group discussion. The study results showed that participants agreed that the consortium should carry out organizational operations based on the principles of transparency, accountability, ethics, sustainability, and fairness. The five basic principles of proposed governance serve as guidelines for governing: (i) organizational governance (structure), (ii) processes and outputs produced by the organization, and (iii) beneficiaries from the implementation of organizational governance. This study contributes to distance learning education to promote governance practices and support a high-quality distance learning education for society.

Keywords: Governance, online-learning marketplace, governance frameworks, power dynamics.

INTRODUCTION

Governance in distance learning refers to the management process that involves managing, supervising, and regulating the various elements involved in the use of technology for distance learning. This includes strategy, policy, planning, implementation, and evaluation of various aspects related to online learning. The

background to governance in e-learning includes several important points. Technological developments, along with advances in information and communication technology, e-learning has become more accessible and more popular (Hanisch, 2023). Technological innovations influence the way teaching and learning is carried out. E-learning has shifted the learning paradigm from traditional methods to more flexible methods, allowing wider access to education anywhere and at any time. In an e-learning environment, governance is needed to ensure efficiency, security, quality, and continuity of learning. Good governance plays an important role in providing a quality learning experience. The use of technology in education raises the need for clear regulations and policies to govern aspects such as data privacy, security, content standards and intellectual property rights. In terms of curriculum development, e-learning requires a curriculum specifically designed for the online learning experience. This governance includes developing and adapting the curriculum according to online learning needs as well as the use of e-learninf flatform (Krucoff, 2011).

Management of e-learning platforms, including maintenance of technology infrastructure, provision of services, technical support, and improvement of user experience, is an important part of this governance (Huynh, 2003). Continuous evaluation of learning processes and outcomes is also important to governance. Continuous improvements in content, teaching methods, and technology are an integral part of this process. Training and development of teaching personnel, e-learning governance also involves training for teachers so they can adapt effective teaching methods in the online learning environment. Effective governance in e-learning is the key to success in providing a quality learning experience, ensuring data security, and achieving educational goals. It also helps align the use of technology with effective pedagogical principles to improve student learning outcomes.

Management of e-learning projects should involve stakeholders in the application of e-learning. The e-learning project is in accordance with the predetermined e-learning strategic planning. E-learning is a big step in education, thousands of hundreds of users access online learning platforms on various platforms with offerings different academic (Sutadji, 2020).

In this digital era, it has been proven that the proper e-learning system implementation provides various advantages and huge benefits. But to achieve the proper implementation is not an easy way since there are many obstacles that must be addressed. Beside the benefits and advantages, such as the other IT based system, e-learning also bring many risks that come from its environment or embedded in (Nurohman, 2021). Information Technology governance (ITG) calls for the definition and implementation of formal practices at the highest level in the organization, involving structures, processes, and relational practices for the creation of business value from IT investments. However, determining the right ITG practices remains a complex endeavor. Previous studies identify IT governance practices used in the health and financial sectors. As universities have many unique characteristics, it is highly unlikely that the ITG experiences of the financial and health industry can be directly applied to universities The aim of this research is to determine the extent of e-learning's performance in terms of governance in expressing stakeholder rights (Bianchi, 2021).

Stewardship theory pertains to the relationship between principals (owners/shareholders) and agents (managers) within an organization. It emphasizes the idea that when managers or agents act as stewards, they prioritize the organization's well-being and act in the best interests of the principals rather than solely focusing on their self-interests (David E. Mills, 2008). Stewardship theory and consortium governance are two concepts often discussed in the realms of business, management, and corporate governance, especially concerning collaborative arrangements among organizations (H.Davis, 1997).

According to (Keay, 2017), key principles of stewardship theory including managerial discretion managers that are entrusted with a certain level of autonomy to make decisions on behalf of the organization based on their expertise and understanding of the firm's objectives. They align their actions with the interests of shareholders and other stakeholders to ensure the company's prosperity over time. They take responsibility for their decisions and actions. This theory is applicable to consortiums of e-leaning marketplace.

Consortium governance refers to the mechanisms and structures put in place to govern collaborations and alliances among different organizations or entities. These collaborative arrangements often occur when multiple organizations come together to achieve common goals, such as research and development initiatives, joint ventures, or industry-wide partnerships (Tagoe, 2022).

Key aspects of consortium governance include decision-making structures, regarding establishing how decisions will be made within the consortium. This might involve consensus-based decision-making, voting systems, or hierarchical structures depending on the consortium's nature and objectives. Rights and Obligations: Defining the rights and obligations of each participating entity (Zavolokina, 2020). This includes contributions, responsibilities, sharing of resources, and the distribution of benefits or outcomes. Organizations need to set up procedures to address conflicts that might arise between the consortium members. This could involve mediation, arbitration, or other dispute resolution processes. Ensuring transparency in operations, financial transactions, and decision-making processes. Additionally, holding participants accountable for their commitments and actions within the consortium. Being adaptable to changing circumstances and allowing for adjustments in the governance structure as the consortium evolves (Purcell, 1982).

Both stewardship theory and consortium governance are crucial in managing collaborations effectively (Siebels, 2012). Stewardship theory emphasizes the importance of trust, accountability, and long-term orientation among the leaders managing these collaborations, while consortium governance focuses on structuring the interactions and relationships among the participating organizations to ensure smooth functioning and achievement of common objectives. This concept also works for distance learning marketplace (e-marketplace).

E-marketplace is a virtual online market platform where companies can register as buyers and sellers to conduct business to business (B2B) or Business to Consumers (B2C) transactions over the internet. The use of the internet has helped remove intermediaries in a transaction. It is a web-based information system which provides opportunities for both suppliers and buyers (Fry, 2001) . It enables the buyers to compare various products and services by different measures like performance, quality, price etc. Buyers get access to a broader range of products and services. On the other hand, the sellers can reach the customers more conveniently and affordably. Sellers gets to enter new markets, find new buyers, and increase sales by generating more value for the buyers (Tagoe, 2022)

E-marketplaces have become increasingly prevalent due to the growth of e-commerce and digital transactions. They offer convenience, accessibility, and a broad reach for both buyers and sellers, fostering a global marketplace accessible from anywhere with an internet connection. These platforms have transformed traditional commerce by providing new avenues for businesses to expand their reach, connect with customers, and streamline their sales processes, while also offering consumers a vast array of choices and easy access to products and services (Standing, 2006). Guide. An e-marketplace is a virtual online market where organizations register as buyers or sellers to conduct business-to-business e-commerce over the internet. There are many types of e-marketplaces based on a range of business models (Wang, 2008).

Previous study regarding e-marketplace has explored information systems, inter-organizational/social structures, and strategic management perspectives (Wang, 2008). This framework suggests a cohesive way to explain key issues such as adoption, success, and impact of e-marketplaces. Furthermore, research conducted by (White, 2007) also explains the electronic market. This exploratory study seeks to provide a qualitative explanation of the specific factors that influence the adoption of the consortium's B2B electronic market. This study is based on a case study of twelve companies trading through three different B2B electronic marketplace consortia. Twenty-six specific factors were identified and their impact on implementation. The identification of many specific factors in this domain provides real and deep meaning for those interested in the future of e-marketplaces. Specifically, the factors identified provide those operating e-marketplaces with a detailed and actionable understanding of the issues they must address to survive and provide users or potential market consortium users with a practical framework that can be used to assess each market (Chang, 2020). Previous studies that elaborate governance for e-marketplace is related to the how the consortium governs the challenge in online education, as part of distance learning.

The governance challenge in an online education marketplace consortium is how to effectively manage, regulate, and coordinate multiple stakeholders (educational institutions, content providers, students, and technology platforms) in a professional setting while maintaining quality, accountability, and fairness. Balancing individual institutions' autonomy with consortium-wide standards, ensuring equitable representation and decision-making power, maintaining academic integrity in a digital, multi-institutional

environment, adapting to rapidly evolving educational technologies and pedagogies, and complying with distinct regulations across multiple jurisdictions are all challenges that must be addressed.

To address this governance problem, Malcolm (2008) provides frameworks for balancing various goals in decentralized systems. It creates a multi-layered governance paradigm that balances centralized oversight and decentralized decision-making. It covers topics such as stakeholder management, decision-making procedures, quality assurance, and technology issues. According to Malcom's framework, it is importance of involving all relevant stakeholders in the governance process. In the context of online education, this would include educational institutions, content providers, students, technology platforms, accreditation bodies, and potentially government regulators or well known as Multi-stakeholder Approach.

The concept promotes consensus-building rather than majority rule. This strategy ensures that all stakeholders' perspectives are heard and considered, which is critical in a varied educational consortium. Malcolm supports a bottom-up approach to policy formation. In an education consortium, this could include incorporating teachers and students in policy development, rather than just administrators. The concept highlights the importance of transparent processes and accountability measures. This is especially important for building confidence among consortium members and assuring the quality of online education. Malcolm's approach understands the necessity for governing institutions to evolve in response to changing conditions, often known as adaptive governance. This is critical in the continuously changing environment of online education and technology. The model addresses the challenge of ensuring fair representation among stakeholders with varying levels of resources and influence (Balancing Representation). This is relevant in education consortiums where institutions may vary greatly in size and resources. Malcolm argues that the legitimacy of governance structures comes from their inclusiveness. This principle could help online education consortiums gain credibility and trust from all participants. The model proposes "soft" governance mechanisms like guidelines and best practices, rather than hard rules. This approach could be beneficial in education consortiums where institutional autonomy is important. It develops best practice guidelines for online course delivery and creates a peer review system for quality assurance.

By adapting Malcolm's multi-stakeholder governance model, online education marketplace consortiums can create more inclusive, flexible, and effective governance structures. This strategy can assist balance stakeholders' different interests while retaining the agility required in the everchanging world of online education. Scholars have questioned the multi-stakeholder method throughout the previous two decades, arguing that the problem of concern should be represented in a balanced manner in order to obtain a sound, consensual, and valid solution (Hofmann, 2016; Taggart & Abraham, 2024).

In essence, these requirements describe what multi-stakeholder approaches today are about in many transnational policy contexts: assembling a pluripartidism group of actors believed to represent the stakes in an issue, developing procedures which ensure a balanced and fair view on the matter, and, based on these conditions, creating outcomes that promise to settle the issue in the long run - outcomes that would most likely be impossible to achieve by less diverse castella. Without a doubt, each of these standards has presented significant challenges: "how to determine representativeness for complex issues among multi-stakeholders in a wide-consortium organization? What constitutes legitimate procedures and effective outcomes that guarantee the fairness of the outcome for all beneficiaries?" (Hofmann, 2016; Taggart & Abraham, 2024).

To answer these challenges, we are expanding the relevance of the Malcom Governance Model by adding sustainability principles and ethical values as a foundation for building structures, guaranteeing processes, and overseeing more measurable outcomes for diverse stakeholders. The principle of sustainability and ethics unites the interests of multi-stakeholders, so that the attribution of power is no longer based on balancing representativeness, but is based on managing power dynamics among multi-stakeholders in organizational structures. According to Kaczur (2022), in order to achieve measurable and beneficial outcomes for multi-stakeholders, procedures are needed to accommodate the effectiveness of command and communication among multi-stakeholders, either structural lines, power lines, or other potential power lines (indirect and circumstantial). Adopting sustainability and ethical principles, as well as regulating power dynamics, is the urgency of this research. Thus, this research can propose a governance framework for e-learning marketplace consortia that is more applicable and relevant.

PURPOSE OF THE STUDY

This research aims to build a governance framework for the e-learning consortium in Indonesia that is relevant to current developments by addressing issues that have been debated in Malcolm's Governance Model for more than two decades, namely: how to determine representativeness for complex issues among multi-stakeholders in a wide-consortium organization? What constitutes legitimate procedures and effective outcomes that guarantee the fairness of the outcome for all beneficiaries?

This research provides a contribution to answering academic debates regarding Information Technology Governance literature developed by Malcom, which is considered a romantic fiction and messy practice, because, at a practical level, it is difficult to implement balancing representativeness among multi-stakeholders. We hope the proposed governance framework will be applicable and relevant for Indonesia Cyber Education Institute (ICE-I). ICE-I as a marketplace of online courses in Indonesia, has missions to provide: (i) equity & massive access to quality online courses through various technologies across time and space, (ii) flexible learning through unbundled online courses for various purposes (formal, non-formal, upskilling, reskilling), and (iii) a blockchain-based learning credential system linked to the job market. To achieve those missions, ICE-I must fulfill the needs of customers as well as protect its stakeholders. So, ICE-I needs to implement governance principles and a mechanism that governs the structure and business processes to achieve its longterm goals.

METHOD

Data and Participants

This study uses a case study approach, which is a qualitative design that involves the investigation that examines deeply into a contemporary phenomenon, specifically the context of ICE-I development of governance model program (Stake, 1995; Yin, 2018). According to Yin (2018), doing case study research is a linear, but iterative process as presented in Figure 1.

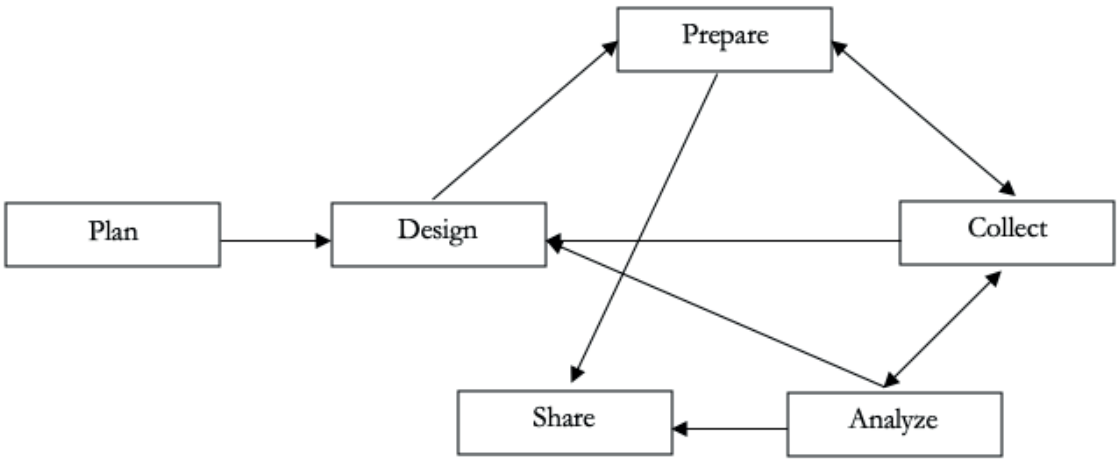

Figure 1. A Case Study Research Phases (Yin, 2018)

After our research plan was granted by Universitas Terbuka (as one of the ICE-I initiator), this study conducted the following research phases:

1. Design phase, final meeting was held on April 11, 2023

   We formulate research problems to clearly articulate the governance challenges specific to online education marketplace consortiums. Thus, we identify key issues such as quality control, stakeholder management, decision-making processes, and technological integration. Furthermore, we conducted a comprehensive review of relevant literature to synthesize insights from various theories and create

a preliminary framework. This might combine elements of multi-stakeholder governance with platform governance and identify areas where it extends or challenges current thinking to build our proposition. The proposition would result in a comprehensive, theoretically grounded, and practically oriented governance framework in the context of online education marketplace consortiums. We also determined unit analysis, data collection, and analysis.

2. Prepare phase, held on Friday, May 19, 2023

   We finalized the written case study protocol, including the proposed governance model that should be validated by ICE-I stakeholders. The written case study protocol was evaluated through interactive workshops with ICE University members.

3. Collect phase, through the FGD on August 15-16, 2023

   Data collection to determine participants opinions on governance frameworks. The participants were engaged in discussions to validate and refine the proposed model.

4. Analysis phase was conducted to code and examine relevant feedback from participants and ascertain that the model is relevant and applicable for ICE-I. We iterate on the model based on feedback and further discussion among researchers, and articulate how this new framework contributes to existing governance theories and models. We also add contextual considerations regarding the uniqueness of ICE-I members and market.

5. Share phase was conducted twice. First share to report our progress report and the second one to report our final report to Universitas Terbuka and ICE-I as the research operator. We highlight the urgency of proposed model that has been validated by participants, especially ICE-I partners and consortium.

Thus, the population of participants for this study was all ICE Institute partners that could potentially use ICE Institute e-learning-marketplaces to provide their e-course services. For the purposes of this exploratory study, it was decided to select a sample from this population using a convenience approach by presenting the proposed frameworks to partners that have an interest in participating in this study. There were 17 participants. There were 17 participants who attended the FGD, which was held in a hybrid manner. Participants represented 10 partner representatives from universities and 7 representatives from educational business institutions. Of the 17 participants, only 5 provided feedback regarding the proposed framework, as shown in Table 1.

Table 1. The Identity of Participants

Partner Code	Type of partner	Timestamp	Age	Educational Background	Membership Preference
P01	University	11:51:42 AM	39	Doctoral Degree	Business partners (participants)
P02	Educational business institutions	2:11:08 PM	27	Bachelor's degree	Business partners (participants)
P03	University	2:16:31 PM	42	Master's degree	Business partners (participants)
P04	University	2:31:53 PM	55	Doctoral Degree	Consortium members (shareholders)
P05	University	3:37:14 PM	44	Master's degree	Consortium members (shareholders)

Data Collection and Analysis

The proposed framework includes: (1) governance principles, (2) governance structure, (3) process, and (4) outcomes. Table 2 presents a summary of the items regarding the proposed framework that were derived from the design phase (Phase 1) and interactive workshops with ICE University members during the preparation phare (Phase 2).

Table 2. The Summary of Dimension and Indicators of Governance Framework

Dimensions	Codes	Indicator Items
Membership	MBR1	Type of membership
		• Consortium members (shareholders)
		• Business partners (participants)
		• Donor
	MBR2	Consortium Member Qualifications
		• Amount of capital contribution
		• Amount of Member Dues
	MBR3	Qualifications of Business partners
		• Credentials
		• Certification
Principles	PSP01	Governance Principles
		• Transparency
		• Accountability
		• Ethics
		• Sustainability
		• Fairness
Structure	STR01	General Meeting of Members
		• The technical voting procedures allow online voting.
		• Each vote at the General Meeting of Members is only for one decision.
		• Minimum attendance of management and supervisors at the General Meeting of Members
	STR02	Supervisory Board
		• Leadership profile
		• Capability
		• Number of members of supervisory board
		• Length of service
		• Supervisory board's meeting
	STR03	Executive Board
		• Leadership profile
		• Capability
		• Number of members of executive board
		• Composition of executive board
		• Length of service
		• Executive board's meeting
		• The role of members of executive board (duty of care, duty of loyalty)
Compliance on Ethics and Regulation	COMP	Risk Management
		• Risk management and compliance.
		• Key risks
		• Risk of tolerance

Performance	PERF	Performance measurement uses a Balanced Scorecard and a self-assessment compensation system. • Stakeholder perspective (30%) • Financial perspective (20%) • Internal process perspective (25%) • Enablers/learning and growth perspective (25%) Executive Board Compensation • Fixed • Performance-based compensation Supervisory Board • Fixed
Transparency	TRAN	Disclosure policy Financial report access policy Sustainability report access Policy Information dissemination and security policy
Member Rights	MBEN	Economic benefits Non-Economic benefits
Rights of other stakeholders	SHRT	Customer service Partner services Donor services

Source: Author, data processed (2023)

Thus, we conducted data collection to validate the governance frameworks through the FGD with ICE Institute partners and members (Phase 3). The aim of the FGD is to uncover their intentions and suggestions regarding the proposed framework.

FINDINGS

Figure 2 visualizes the proposed governance framework constructed from Phase 1-3.

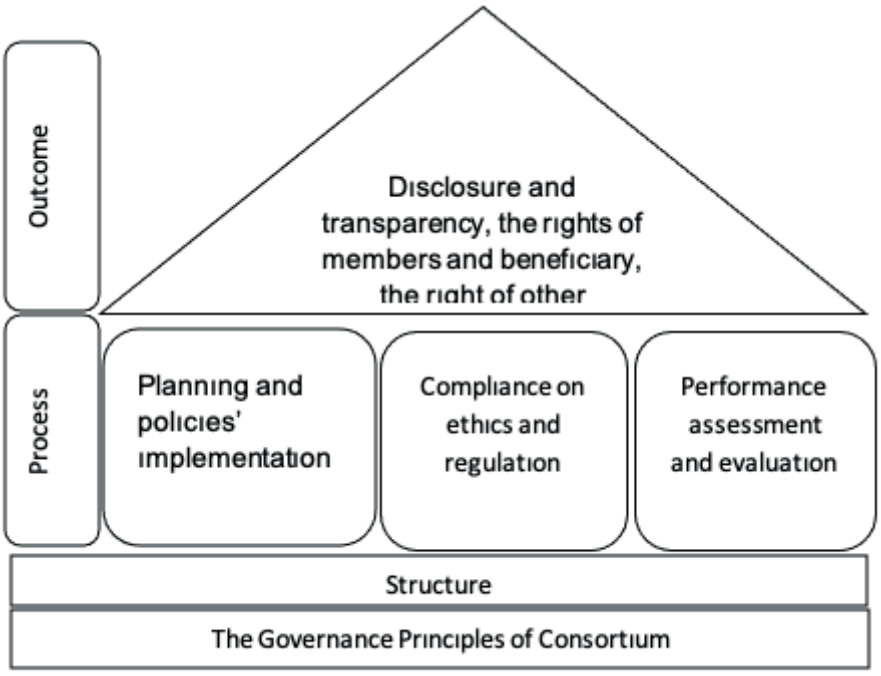

Figure 2. Multistakeholder Governance Framework for E-Learning Marketplace: Power Dynamic Perspective

This framework answers the challenge of the Malcolm Governance Model, which is considered unclear regarding issues of the representativeness and fairness of the outcome for all beneficiaries, by: (i) adding sustainability and ethics to the principles of governance, (ii) regulating power dynamics to regulate relationships between stakeholders as outlined in the organizational structure, and (iii) regulating performance evaluation boards and management to measure the effectiveness of outcomes for beneficiaries.

The framework also considers geographical and institutional context by adapting general governance guidelines and regulations in Indonesia, namely: (1) Law Number 28 (2004) regarding Foundations, (2) Law Number 40 (2007) concerning Limited Liability Companies, (3) General guidelines governance of Indonesian non-profit organizations. This framework is in line with the Power-Structure Model of Non-Profit Governance developed by (Bruni-Bossio & Kaczur, 2022). The framework outlines the power dynamics found in several formal connections seen in non-profit organizations. These interactions include those between funders and the organization, management and the board or board chair, and board members and the board chair. The power inherent in the organizational structure provides legitimacy for carrying out their respective duties and functions. For this power to be effective, non-profit organizations must consider the needs and interests of stakeholders. By taking stakeholders' opinions into account when gauging effectiveness, governance processes for NPOs will be greater in quality and more comprehended (Wellens & Jegers, 2014).

DISCUSSIONS AND CONCLUSION

The Governance Principles

In addition to transparency, accountability, and fairness, we add ethics and sustainability to the governance principles that can be adopted by the ICE-Institute consortium. Sixty percent (60%) of participants agree to adopt all five principles. The five basic principles of proposed governance serve as guidelines for governing: (i) organizational governance (structure), (ii) processes and outputs produced by organization, (iii) beneficiaries from the implementation of organizational governance.

Table 3. Governance Basic Principles

Governance Principles	Number	Percentage
Transparancy, Accountability, Ethics, Sustainability, and Fairness	3	60
Transparancy, Sustainability	1	20
Transparancy, Accountability, Sustainability, and Fairness	1	20
Grand Total	5	100

Source: Author, data processed (2023)

Transparency in the context of governance describes how easily accessible and visible consortium governance systems are. For a project to have good governance, all parties involved, both internal and external, must be aware of the governance structures and procedures in place, the legitimate decision-making mechanisms that have been adopted, and the authority and responsibility assigned to various actions within the consortium. This includes outlining the procedures that are in place for challenging judgments, voicing objections, or concerns, requesting corrections, or suggesting modifications. Transparency also turns into one of the fundamental tenets of data security (Morisson, 2020).

Accountability can be defined as a program evaluation that places special emphasis on holding individuals accountable for meeting predetermined standards of satisfactory performance. Accountability demonstrates to stakeholders whether the consortium programs that are implemented by the consortium have achieved the intended outcomes (Zhang, 2021).

Regarding the implementation of the sustainability principle, the following primary vectors of the educational paradigm's evolution must be identified in order to make it adaptable to contemporary socio economic life, including the requirement for sustainability from a global society, as a result of global transformational

processes in socioeconomic life: (i) innovation; (ii) socialization and systemic group interaction and development; (iii) stable improvement and professional knowledge and skill acquisition; (iv) application of advanced experience in educational programs; and (v) harmony with the business environment and quality feedback in the system of integrated labor resource development in particular product segments.

These changes necessitate a continuing consideration of modern education as a social institution. The educational process, which addresses intricate social, economic, and environmental issues, is in line with the objectives of sustainable development. To address these issues, education should consider other points of view, different knowledge systems, and recent scientific advancements made possible by the advancement of digital technologies, including e-learning. E-learning offers the following benefits by directly putting the ideas of equality and inclusivity into practice: (i) unity of the educational process; (ii) ideal circumstances for setting up teacher-student interaction; (iii) students' methodical mastery of the course material; and (iv) constant mastery of the culture via the development of the relevant skills and information (Zhang et al, 2020). Therefore, the consortium should consider social and environmental aspects of its business processes as part of its social and environmental responsibility. Social and environmental responsibility is a common interest of stakeholders, so as to reduce conflicts of interest between stakeholders. Social and environmental responsibility reduces the sentiment of group representation, thus facilitating strategic alignment between the goals of the consortium and stakeholders.

In conjunction with the COVID-19 epidemic, recent developments in higher education institutions are facilitating the deployment of educational technologies as a trajectory towards Education 5.0 (teaching, research, community service, industrialization, and innovation). E-learning systems are being used more and more for both individual and collaborative learning. The problem with these learning platforms is that they lessen or do away with face-to-face connections among students in higher education. The rise in unethical learning practices associated with virtualized learning has become a source of concern. Because of this, the ethics that govern the e-learning process determine the quality of the e-learning itself (Chigora et al., 2022). Furthermore, an earlier study identified the factors that determined the three elements of the E-learning Success Model (ESM): information quality (IQ), system quality (SyQ), and service quality (SvQ). Fairness is among the characteristics that determine the ESM's service quality component (Jaoua et al., 2022). Thus, the application of ethics in consortium governance binds the interests of stakeholders so that they always prioritize service quality, not representation of the interests of each group. Fairness is achieved when there is no domination of the interests of certain groups over the interests of other parties.

Those principles governing organizational structure regulate three aspects, namely: (1) Roles and Responsibilities of the Boards (Executives and Supervisory Boards); (2) Composition and Remuneration of the Boards; and (3) Cooperation between the Boards.

The Governance Structure

The boards carry out their roles and responsibilities independently to create sustainable value for the long-term best interests of the organization and its members and/or beneficiaries, considering the common interests of stakeholders. The executives carry out the administration or management of the organization, while the supervisory boards supervise the executives. In addition, this principle also regulates the performance assessment of executive and supervisory boards, handling conflicts of interest that occur among them, and increasing the competence of the board's members.

The composition of the board's members must consider diversity in terms of knowledge, abilities and expertise needed to fulfill management or supervisory roles. Apart from that, it is important to establish a remuneration policy to encourage Executives to prioritize the long-term interests of the organization based on sustainability principles, as well as the need for transparent disclosure of remuneration policies and information received by them. Therefore, we discuss the application of principles related to the board's member selection mechanisms, composition, and remuneration policies for the ICE-Institute consortium.

(Palladino & Santaniello, 2021)(Palladino & Santaniello, 2021)Apart from regulating the composition, role, and function of organs in the organizational structure, the consortium should also consider the power dynamics between stakeholders. In an era of transparency and diverse use of social media and communication,

communication and information are more accessible and intense. Communication and coordination in an organization become more dynamic. However, the idea of multistakeholderism indicates a structural weakness in dealing with the dimension of power, resulting in governance procedures that disadvantage less well-resourced participants (Palladino & Santaniello, 2021). Therefore, Figure 3 illustrates power dynamics within traditional organizations.

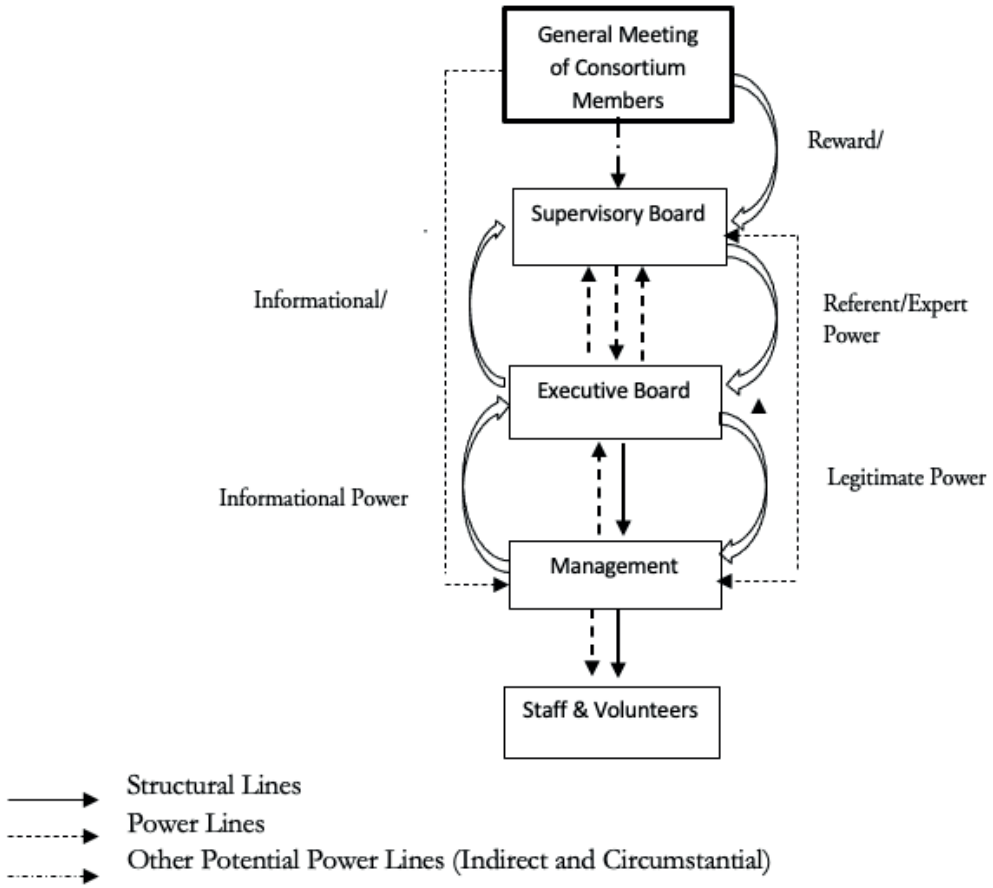

Figure 3. Proposed Consortium Power-Structure

Source: Power-Structure Model of Non-Profit Governance with Modification (Bruni-Bossio & Kaczur, 2022).

The dashed lines imply power dynamics between groups/individuals, whereas the solid lines depict expected relationships within the organization. Consortium members, despite not being part of the organizational structure, hold power over managers and thus the entire consortium. In contrast to the supervisory board, consortium members have indirect and circumstantial power. The supervisory board rarely interacts directly with consortium members except in exceptional circumstances, as indicated by the smaller dotted line.

Although the organizational structure shows management is less powerful than the board of directors, participant responses indicate that management holds significant power over the board chair and other members due to their capacity to regulate information flow. Managers hold control over their staff, which relates with the organizational structure.

Despite the executive board's position at the top of the organizational hierarchy, a constant power struggle exists among boards. Executive boards face challenges in obtaining relevant information from management due to their role in representing the board. While the executive board has some power, some board members, particularly those with prominent personalities or relevant abilities, may have influence over the board chair or other members.

In short, consortium stakeholders need to be aware of their relationships with other stakeholders and the flow of power and the types of power they can use to influence management policies and operations. Thus, they have a clear basis of legitimacy that ensures their interests are aligned with those of the consortium and achieve sustainability as their common goals. Apart from the legitimacy to utilize their power, stakeholders need to adhere to a code of ethics. Therefore, it is recommended that the consortium prepare a code of ethics, one of which aims to regulate relationships between stakeholders.

In addition to the stakeholders relationship and power dynamic among them, FGD participants suggest that as follows:

> *"The management consists of a combination of consortium members and several supervisors from providers, government, practitioners".*
>
> *"The Structure consists of a Board of Trustees, Chairman, and Members."*
>
> *"The Executive Boards consist of Chairman, Secretary, and three managerial functions as needed."*
>
> *"The Executive Boards Consists of management, content, IT and services."*

Table 4 presents the feedback regarding the general meeting of members policy during the FGD. The general meeting is crucial to accommodate power dynamics among stakeholders.

Table 4. Feedback Regarding General Meeting of Members Policy

General Meeting of Members Policy	Responses					
	P01	P02	P03	P04	P04	Average
The technical voting procedures allow online voting	6	6	5	6	5	**5.6**
Each vote at the General Meeting of Members is only for one decision	6	4	3	6	5	**4.8**
Minimum attendance of management and supervisors at the General Meeting of Members	5-8 times	5-8 times	< 4 times	5-8 times	5-8 times	**5-8 times**

Source: Author, data processed (2023)

Using a scale of 1-6 (strongly disagree-strongly agree), participants agreed that the general meeting of members provided the option of an online voting procedure with a mean score of 5.6. Participants also agreed that the general meeting of members uses a mechanism of one vote for one decision (mean score is 4.8). Participants suggested that the minimum attendance of supervisory and executive board member meetings is 5-8 times per year. We offered them the following options for the attendance of supervisory and executive board member: less than 4 times, 5-8 times, 9-12 times, or more than 12 times per year.

Leadership Profile: Supervisory and Executive Board

The application of sustainability principles and ethical values requires adequate leadership support, so that dynamic power can be exercised effectively and constructively. We elaborated on the leadership profile of the consortium's supervisory board to the participants during FGD:

> *"(They should be) responsible, understand business and financial aspects, have a future vision related to sustainability, be adaptive and open minded, and be able to provide direction for the future progress of the consortium."*

Meanwhile, the executive board leadership profile, according to participants:

> *"(They) have leadership spirits and experts in their fields, diversified, inclusive, representative, professional, adaptive, and open-minded, and are also able to provide direction for day-to-day operations."*

Participants believe that the supervisory board must have adequate capacity demonstrated by experience, be adaptive to market changes, be competent in managing online learning, and have integrity. A review of the consortia's management practices revealed a few important variables that affected the selection of methods and procedures. Management decisions were significantly influenced by prior experiences (Tagoe et al., 2022).

"(They) have experience, are open to every change in market priorities and challenges, look beyond the general benefits not only from the financial side, have online learning competencies, and are firm, honest, and credible."

Regarding the capacity of the executive board, participants did not specifically convey the capacity that the executive board needs to have other than aspects of expertise and commitment.

"(They) have appropriate expertise, representation from consortia, government, providers, or other partners, are adaptive and open-minded, and can actively attend important meetings."

The number of consortium supervisory boards that participants expect is in the average range of 4-5 people, although it does not rule out the possibility of being in the range of 2-3 people or above 5 people. The empirical literature has produced inconsistent and conflicting results when examining the correlation between board size and company performance. A critical analysis of this literature reveals that, despite the tendency for large board sizes to have more negative effects than positive ones, earlier research was unable to provide a compelling argument for why somewhat larger boards should have a negative impact on performance. These contradictory results could be explained by the possibility that board size alone does not affect business performance. Instead, there is a greater likelihood that there is a non-monotonic link between board characteristics—like size and leadership structure—and business success, which may change depending on how these qualities interact. For instance, if the firm has a large board size and at the same time decides to follow a CEO duality structure, then this decision is more likely to detract from its financial performance. This is because CEO duality may detract from the effectiveness of the board of directors by reflecting the relative power of the CEO in setting the board's agenda, controlling information flow, and weakening the independence of outside members (Elsayed, 2011).

As for the length of services of supervisory boards, 20% of participants suggest 3 years and the rest of them suggest 5 years. According to participants, the composition of the executive board is a combination of representatives from consortium members, providers, government, and practitioners. The management structure consists of a Board of Trustees, Chairman, secretary, and three members who oversee the areas of business operations, content, information technology and services.

According to a study, diversity on the board has a non-linear relationship with performance, with the effect of diversity being more significant when there is a significant proportion of minority representatives. However, different board and diversity features have a positive impact on bank performance. The primary justification for the board's diversity is that they are more likely to be inventive, imaginative, and open to considering a larger variety of options when making decisions. More diverse boards should also ensure that opposing viewpoints are taken into account, safeguard minorities, and be more difficult to influence. A significant correlation has been observed between a more diverse board and enhanced corporate financial performance. Additionally, diverse boards have the potential to assist organizations in more efficiently attracting and retaining talent. But there could be a price to diversity: diverse boards can be less effective; decisions might move more slowly; and there might be fewer opportunities for consensus (Arnaboldi et al., 2020).

Process

Risk Management

The application of sustainability principles and ethical values is expected to be the foundation for determining risk management policies and strategies. Boards can use their legitimacy power to determine the consortium's risk management policies, while management can use its information power to determine strategies and risk appetites that are in line with the consortium's long-term goals.

Based on the input of the participants, management needs to pay attention to and control the key risks, including risk of cost, returns of long BEP, higher investment costs, digital content IP, joint activities, and lack of student enthusiasm. The risk tolerance that is expected to be managed by management revolves around medium and high risk. Unfortunately, no one mentioned the social and environmental risks that may influence the operation.

Building trust is a critical factor in the creation of an online marketplace. In the digital realm, trust has additional challenges that must be addressed to ensure economic success and shield companies from self-

serving conduct. There is a difference in transaction-specific risks on and offline. Market makers are using a variety of measures, such as digital signatures, regulatory frameworks, insurance plans, and extensive security systems, to build trust and lower risk. An essential component of building trust is the involvement of third parties, such as credit agencies, escrow services, risk management firms, and certifying bodies (Standing et al., 2006).

Performance

Consortium members can use legitimacy and reward power to determine performance assessments for supervisory and executive boards to ensure the compliance of boards and management for the establishment of sustainability and ethical values. We elaborated on the participants' opinions accordingly.

Regarding the performance appraisal system, 60% of participants believe only to consider the achievement of financial indicators, and 20% of them suggest considering financial and non-financial aspects. Therefore, we propose measuring organizational performance using a balanced scorecard perspective whose composition is as follows: (i) stakeholder perspective (30%); (ii) financial perspective (20%); (iii) internal process perspective (25%); and enablers/learning and growth perspective (25%).

Because non-profit organizations have a focus on social mission and values and for-profit enterprises primarily focus on profit maximization, performance measurement systems for non-profit organizations appear to be more complex than those for for-profit businesses. Furthermore, non-profit organizations have to manage the demands of numerous stakeholders, and the fulfillment of their organizational objectives is not assured by their financial stability. Therefore, in addition to organizational viability, performance measurement systems for non-profit organizations should also include the organization's social effect. Therefore, it is essential to build performance measurement system frameworks, tools, procedures, requirements, and indicators that consider the opinions of many stakeholders and handle these unique characteristics of non-profit organizations (Treinta et al., 2020).

We then asked the FGD participants' opinions regarding the compensation components for the executive and supervisory boards. We asked them to provide opinions with a score range of 1 (strongly disagree) to 6 (strongly agree) regarding two things, namely: (i) the executive board's compensation component should contain a fixed composition and performance-based variables; and (ii) the supervisory boards compensation composition should only contain fixed components. Three of FGD participants strongly agree that the executive board compensation component should contain a fixed composition and performance-based variables, and two of them agree that the executive board compensation component should contain a fixed composition and performance-based variables. Meanwhile, only two FGD participants strongly agree that the supervisory board compensation composition should only contain fixed components, one participant agrees, and two of them disagree that the supervisory board compensation composition should only contain fixed components. It suggests that FGD participants encourage the executive boards, and the supervisory board's compensation component should contain a fixed composition and performance-based variables. Management's performance measurement in non-profit organizations can use the multidimensional and integrated model of non-profit organizational effectiveness. An effective management and program model "captures two distinct levels or dimensions of effectiveness." It is possible to further break down management and program effectiveness into two subcomponents: capacity and outcomes (Sowa et al., 2004; Treinta et al., 2020). Consortium members use legitimacy and reward power to ensure the boards and management deliver the outcome effectively, while boards and management may use informational power to influence consortium members' perceptions regarding their capacity fairly.

Outcome

Some opponents have questioned whether a multi-stakeholder dialogue would have a practical impact. Another criticism is that outcome policy ends up negotiating useless outcome documents, rather than solving genuine problems that matter to the people out there' (Hoffman, 2016). To overcome this problem, the impact of the consortium's outcomes must be measurable for stakeholders, especially consortium members, partners, donors, and consumers. To be able to measure outcomes fairly, transparency policies and

disclosure, as well as expected benefits for stakeholders. Therefore, we discussed the consortium's disclosure and transparency policies, along with the consortium's benefits for stakeholders.

Table 5. Respondent Feedback regarding Transparency and Disclosure Policy

Point of Concerns	P01	P02	P03	P04	P05	Average Score
The ICE-I Consortium must make the widest possible disclosures to all ICE-I stakeholders.	6	6	5	6	3	5.2
The ICE-I Consortium must provide the widest possible access to financial reports to all stakeholders.	6	6	5	6	5	5.6
The ICE-I Consortium must provide the widest possible access to sustainability reports to all stakeholders.	6	6	5	6	5	5.6
The ICE-I Consortium must have an information dissemination and security policy that must be adhered to by stakeholders	6	6	5	6	5	5.6

Source: Author, data processed (2023)

There were five participants who provided feedback during the FGD as presented in Table 4. We asked them to give their opinions using a scale of 1-6 (strongly disagree-strongly agree) regarding policies: (i) disclosure; (ii) access to financial reports; (iii) access to sustainability reports; and (iv) dissemination and security of information for stakeholders. On average, they agree that the consortium must have a policy regarding the full disclosure, provide stakeholders with access to financial reports and sustainability reports, and information dissemination and security policies.

"Transparency" in the context of governance refers to the reachability and visibility of consortium governance mechanisms. For a project to have good governance, both internal and external stakeholders must be aware of the governance structures and procedures in place, the mechanisms for lawful decision-making that have been implemented, and the locations of power and responsibility for various acts within the consortium. One of the fundamental tenets of data protection is transparency. When personal information is gathered from a subject, the controller of that data is required to give that subject a list of details, including who will have access to it and why. This data needs to be accessible and meaningful (Morrison et al., 2020).

Table 6 presents feedback from participants during the FGD regarding the expected economic and non-economic benefits for stakeholders. In terms of economic benefits, participants expect direct economic benefits, such as dividends, margins, and profit. The expected indirect economic benefits for stakeholders, such as business opportunities. Surprisingly, there is a participant who expects indirect economic benefits in the form of increasing the economic capacity of the surrounding community. This opinion can be a suggestion for the consortium to consider implementing sustainable business that synergizes economic, social, and environmental aspects.

Table 6. Participants Feedback Regarding Economic and Non-Economic Benefits for Stakeholders

Participants	Economic benefits expected by members/partners/ donors of the ICE-I consortium	Non-economic benefits expected by members/ partners/donors of the ICE-I consortium
P01	Dividend.	Company publication through the display of the company logo
P02	Business opportunities.	Transfer of knowledge related to higher education education
P03	Introducing institutions, so that institutions are more widely known in the market and gain value both in terms of quality and margin.	Expanding networks in the field of online learning development.
P04	Increasing the economic capacity of the surrounding community.	Increasingly known to the public.
P05	Increasing profits for the university.	Recognition of lecturer competency.

Source: Author, data processed (2023)

In terms of non-economic benefits, participants expect that their participation in the consortium can become a channel for company publication and branding, networking, and knowledge transfer related to online learning education. In short, the outcome should be measurable and deliver economic and non-economic impacts to beneficiaries.

CONCLUSION

This paper proposes a governance model framework for the E-Learning Marketplace consortium to address challenges to the Malcom's Governance Model, especially regarding the unclear representation of power. This problem was overcome by adding the principles of sustainability and ethics, emphasizing the power dynamics between stakeholders contained in the consortium structure, measuring performance, and determining measurable outcomes.

Good consortium governance must ensure that governance principles become the basis for the functioning of the organizational structure, maintain that organizational processes run accordingly, and ensure that the outcomes achieved can be assessed by stakeholders and are also beneficial to them. We propose a Power-Structure structure model of Non-Profit governance that is adapted to the online learning marketplace context, instead of the traditional structure model that considers power lines among positions in an organization.

We underline the importance of risk management and performance assessment to oversee the consortium's business processes. A consortium that operates in the online education industry is advised to have a medium and high level of risk tolerance. Performance assessments that consider both financial and non-financial aspects are expected to better reflect the nature and characteristics of the organization that are in line with measurable outcomes.

This paper has several limitations, particularly the framework do not consider quality assurance that relevant with evolving educational technologies and pedagogies. Future research is suggested to consider how the framework can remain relevant with evolving educational technologies and pedagogies and updating of the governance model accordingly.

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CRITICAL FACTORS INFLUENCING FACULTY'S SWIFT TRANSITION EXPERIENCES TO VIRTUAL LEARNING ENVIRONMENTS DURING EMERGENCIES: A MIXED-METHODS STUDY OF A SEMI-GOVERNMENT EMIRATI UNIVERSITY

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ABSTRACT

The COVID-19 pandemic precipitated a rapid shift to virtual learning environments (VLEs) in higher education institutions (HEIs), presenting a complex array of challenges and opportunities. This study investigates the critical factors influencing faculty members' swift transition to VLEs during emergencies, focusing on a semi-government Emirati university. Using a concurrent mixed-methods approach for data collection, the analysis incorporates both descriptive statistics and Structural Equation Modeling (SEM) for quantitative data, as well as thematic analysis for qualitative data. The results reveal various challenges faculty face, including reduced student engagement, limited prior experience in online teaching, and technological barriers. However, the transition also unveiled opportunities to enhance teaching and learning through innovative pedagogical strategies and technology-enhanced platforms. The SEM analysis elucidated the effects of demographic variables such as gender, age, and years of experience on adopting e-learning tools and the support received during the transition. These insights are critical for HEIs, guiding strategic decision-making to optimize VLE implementation. The study offers several recommendations, including customized training programs, policy revisions, reduced teaching loads, enhanced technological support, and the incorporation of innovative teaching methods. These strategies are essential for strengthening VLE deployment in HEIs, enhancing resilience during emergencies, and fostering ongoing educational improvements.

Keywords: Virtual learning environments, higher education institutions, crisis situations, teaching and learning, structural equation modeling.

INTRODUCTION

During the COVID-19 pandemic, higher education institutions (HEIs) rapidly integrated virtual learning environments (VLEs) as part of a wider shift towards innovative pedagogies and advanced technological solutions. This transition, however, presented significant challenges including reduced student engagement, a deficiency in online teaching expertise, and pervasive technical issues (Mete et al., 2022; Maatuk et al., 2022; Shambour et al., 2022; Zhang et al., 2022). Despite these difficulties, the crisis also catalyzed the adoption of creative educational practices and technology-enhanced learning platforms, promoting faculty development in online pedagogies and tailored learning strategies that improve student learning outcomes (Svihus, 2023; Zhang et al., 2022; Shanableh et al., 2022; Karaca & Ilkim, 2021; Martin et al., 2021).

In the context of the UAE, the need to consolidate the advancements made through the adoption of VLEs and to enhance preparedness for future crises, including environmental disasters like floods, is pressing. Such events also demand robust and flexible educational strategies to ensure continuity in education. The literature indicates a growing exploration among HEIs of diverse platforms suitable for emergency scenarios, including both VLEs and social computing software, which could offer valuable insights into effective teaching and learning strategies during crises (Bawaneh & Malkawi, 2023; Moser et al., 2021; Hew & Cheung, 2014; Hodges et al., 2020). Documenting stakeholder experiences and perspectives on using VLEs during such emergencies is essential for identifying ongoing challenges and for developing strategies to improve educational processes (Joseph et al., 2022). This contextual data is crucial for enabling educational leaders and planners to manage HEIs effectively under various adverse conditions.

This study focuses on the enabling and hindering factors experienced by faculty members while swiftly transitioning to VLEs in UAE HEIs. By examining the barriers and facilitators of VLE adoption during the COVID-19 pandemic and considering implications for other emergencies such as floods, this research aims to deepen the understanding of how rapid transitions to online education can be effectively managed. The following sections will detail the related literature, methodology, findings, and conclude with a discussion that synthesizes insights from the UAE experience with broader implications for emergency preparedness in education.

LITERATURE REVIEW

Virtual Learning Environment

Within the higher education sector, crises and fluid situations, including COVID-19 and various natural disasters, have compelled institutions to revisit and refine their approaches to crisis management. Moreover, the impact of these challenging situations extends beyond immediate physical damage, disrupting operational continuity and academic scheduling within higher education. Cutter et al. (2010) stress the critical importance of readiness and resilience in educational frameworks, suggesting that universities play a pivotal role in the communal response and recovery processes. The onset of the COVID-19 pandemic has radically transformed the higher education landscape, accelerating the transition to Virtual Learning Environments (VLEs) and bringing several challenges and opportunities (Shanableh et al., 2022; Marinoni, Van't Land, & Jensen, 2020).

Virtual Learning Environments (VLEs) are web-based platforms that integrate a suite of tools for online communication, collaborative learning, content delivery, assessment, feedback, and course management. Dillenbourg et al. (2002) describe VLEs as online spaces crafted for information sharing, social interaction, active student engagement, and the deployment of innovative pedagogies through adaptive technologies. These platforms offer flexible and accessible learning experiences, designed to surmount the constraints of traditional classrooms and cater to the individualized needs of learners (Aderibigbe et al. 2023a; Yilmaz et al., 2022; Bashir et al., 2021; Gillett-Swan, 2017). For example, VLEs allow students to access educational materials and engage in learning activities at their convenience, transcending geographical and temporal boundaries to accommodate varied schedules and commitments (Hodges et al., 2020). Educators can leverage these platforms to provide tailored learning opportunities and feedback, responding to the unique needs and abilities of each student (Aderibigbe et al., 2023b; Becirovic & Dervic, 2023; Archambault et al., 2022). Furthermore, through the use of adaptive technologies, multimedia resources, and social computing tools, VLEs foster collaborative interactions and immersive simulations, enriching the educational experience for students from diverse backgrounds (Aderibigbe et al., 2023b; Almaiah et al., 2022; Conrad et al., 2022; Elshami et al., 2022; Joseph et al., 2022). Additionally, VLEs offer cost-effective means for resource sharing and remote class participation, eliminating travel requirements and physical infrastructural dependencies (Aderibigbe et al., 2023a). Moreover, the platforms' analytics capabilities enable educators and institutional leaders to formulate data-driven educational strategies and pedagogical approaches tailored to various student needs (Blessinger & Wankel, 2013).

Despite their transformative potential, faculty may encounter several challenges while navigating VLEs and utilizing their integrated tools. Technical difficulties such as internet connectivity issues, device compatibility problems, and resource shortages during peak demand periods are commonly reported (Hodges et al., 2020; Mishra et al., 2020; Joseph et al., 2022; Almaiah et al., 2022; Conrad et al., 2022; Elshami et al., 2022). A lack of familiarity with new VLE features can hinder the development of engaging content and effective assessment methods, particularly in the early stages of adoption (Bao, 2020; Hew & Cheung, 2014; Hodges et al., 2020; Mishra et al., 2020). Additionally, limited capabilities in leveraging collaborative tools and social computing software can affect student engagement and learning outcomes. Faculty may also feel overwhelmed by the demands of managing online learning, which can be more time-intensive than traditional methods (Hew & Cheung, 2014). Concerns about maintaining academic integrity and the lack of social interaction compared to face-to-face environments further complicate the use of VLEs (Hew & Cheung, 2014; Hodges et al., 2020; Mishra et al., 2020).

The ease with which faculty transition to VLEs during emergencies can depend on factors such as readiness and institutional support (Pham et al., 2022; Puskulluoglu et al., 2022). Faculty with proficiency in technology and social computing are typically more adaptable to new VLEs (Bao, 2020). The quality and comprehensiveness of training support offered by institutions are crucial in building faculty confidence and effectiveness in these environments (Aderibigbe et al., 2023a; Marey et al., 2022; Mncube et al., 2021). The availability of necessary resources, pedagogical adaptability, and collegial support also significantly impact faculty's transition to VLEs under challenging conditions (Li et al., 2023; Luebstorf et al., 2023; Gasmalla et al., 2022; Joseph et al., 2022). Workload management and supportive workplace cultures that promote collaboration are additional determinants of educators' successful adaptation to VLEs (Bates, 2019; Trust

& Horrocks, 2017). Faculty experiences with VLEs, including both challenges and opportunities, may also vary based on demographic factors such as gender, age, and specialization (Becirovic & Dervic, 2023; Archambault et al., 2022; Hradecky et al., 2022; Treve, 2021; Liu et al., 2020).

Theoretical Framework for VLE Adoption

In the existing body of research, numerous theoretical frameworks are proposed for effectively integrating VLEs and online education systems. Some of these frameworks are summarized in Table 1:

Table 1. Theoretical frameworks for VLE adoption

S/N	Theoretical Framework	Assumptions
1	Technology Acceptance Model (TAM) (Davis, 1989)	It pays attention to the factors influencing individuals' acceptance and utilization of technology. It identifies two main factors that significantly determine whether someone will embrace a new tool or technology: perceived usefulness (PU) and perceived ease of use (PEOU).
2	Community of Inquiry (CoI) (Garrison, Anderson, & Archer, 2000)	It emphasizes the need to maintain three types of presence when adopting VLEs for effective teaching and learning: social presence, cognitive presence, and teaching presence
3	Activity Theory (Engestrom, 1987)	It emphasizes the need for activities fostering interaction between individuals, tools, and learning environment as essential for effective teaching and learning in VLEs
4	Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006)	For effective transition to VLEs and adoption of technology, it proposes that educators need to be equipped with knowledge and skills in three key: emphasizes need for educators to possess knowledge and skills in three key areas: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Educators must understand how to effectively use technology tools (TK) to deliver instruction and support student learning. They should also apply pedagogical approaches (PK) suitable for online environments, such as collaborative learning, project-based learning, or flipped classroom models. Also, instructors must ensure their content knowledge (CK) is crafted in line with online formats, learning objectives, curriculum standards, and the technological tools employed requirements.
5	Diffusion of Innovations Theory (Rogers, 1995)	It focuses on the process of adopting and diffusing new technologies innovatively with five main areas for consideration: relative advantage (over approaches), compatibility (with the teaching goals), complexity (of technology integrity is addressed), trialability (in the form of experiment and piloting schemes), and observability (by sharing data related to desired results and best practices).

The theoretical frameworks detailed in the preceding table offer a systematic methodology for the effective adoption of VLEs during emergencies. These frameworks are instrumental in assessing faculty acceptance and ensuring their proactive engagement with well-defined roles. The application of these theories aids in designing interactive activities that are supported by necessary technical, pedagogical, and content knowledge. Utilizing these theoretical perspectives facilitates strategic planning and the deliberate implementation of VLEs in crisis contexts, including essential steps like piloting and thorough evaluation of the adoption process. Consequently, the following research questions guide the data collection and analysis in this study:

1. What are the hindering conditions for faculty adoption of VLEs during crises?
2. What are the major enabling factors for rapid transition and effective integration of VLEs by faculty during emergencies?
3. To what extent do the hindering and enabling factors experienced by faculty vary across different academic disciplines, age groups, and genders?
4. How can institutions enhance the teaching and learning process within VLEs during and after crises?

METHOD METHODOLOGY

Research Approach

This study employed a concurrent mixed methods approach involving quantitative and qualitative data from a survey questionnaire. This approach was adopted to delve deeply into the complex issues surrounding the faculty experience of both enabling and hindering factors during the transition to VLEs within challenging and emergency educational environments. Quantitative data provided structured numerical insights, offering statistical validation and clarity on various aspects of the transition process. On the other hand, qualitative data offered rich contextual understanding and diverse perspectives, capturing the subtleties and complexities of faculty experiences. So, combining quantitative and qualitative data allowed for robustly comprehensive, shared, and nuanced results to explore complex issues (Shorte & Smith, 2017).

Participants and Data Collection

In this study, 142 faculty members participated, consisting predominantly of males (70%), with the remainder being females. The demographic variables collected included age, years of experience, and academic college affiliation, which were categorized into three groups for analytical clarity: Medical, Science, and Social Sciences. Detailed demographic data of the respondents are presented in Figure 1. Data collection commenced after receiving approval from the University Research Board (VCRG/R438/2020). All faculty members from the study context were invited to complete an online questionnaire. Following three reminders over five months, the participating sample provided consent and completed the questionnaire. This procedure, using a self-selected non-probability sampling technique, allowed faculty to voluntarily choose whether to participate in the study (Etikan et al., 2016).

Data Validity and Credibility

The reliability of the questionnaire results was assessed using Cronbach's Alpha (α), a measure of internal consistency reliability (Tavakol & Dennick, 2011). This method evaluates the homogeneity of measurement items within a domain by determining the extent to which they are correlated, thereby providing an estimate of the consistency of the scale. Reliable responses are indicated by a high α value, approaching 1.0. A threshold α value of 0.7 is generally considered acceptable for deeming the responses reliable (Tavakol & Dennick, 2011). The qualitative data were subjected to an iterative process of validation through thorough evaluation and feedback sharing by the authors, thereby lending credibility to the results (Lincoln and Guba, 1985). Essentially, the authors' discussion about the research process and emerging themes ensured the data's validity (Bryman, 2016) and trustworthiness (Morse et al., 2002). Moreover, robust discussion drawing on quantitative and qualitative data further strengthened the outcomes of the study (Bryman, 2016).

Data Analyses

Data collection and analysis procedures should be clearly explained with a reference to the role and competency of the researcher(s). The quantitative data in this study were analyzed using descriptive statistics and structural equation modeling (SEM). SEM was chosen due to its capability to construct latent variables from observed indicators, providing a robust framework for testing theoretical models (Ahmad et al., 2017). Specifically, the Partial Least Squares (PLS) approach to SEM was employed to examine the interrelationships among variables (Bang et al., 2000). Additionally, PLS computations were segmented by target categories (binary and categorical) in a Multigroup Analysis (MGA). This analysis facilitated the examination of significant differences across predefined data groups, assessing group-specific parameter estimates (Hair et al., 2017). The SEM-PLS MGA was conducted using SmartPLS 4.0 software (Ringle et al., 2015). Complementing the quantitative analysis, qualitative data were inductively subjected to thematic analysis. This approach allowed for the identification of themes directly from the participants' responses, highlighting common patterns in their perspectives (Braun & Clarke, 2006). This procedure involved a deep engagement with the data through extensive reading, a crucial step in developing initial and significant codes Throughout the process, themes were carefully crafted and scrutinized to accurately reflect the data set, thus ensuring the reliability of the emerging themes and supporting vignettes (Braun & Clarke, 2006).

RESULTS

Quantitative Data

Frequency Analysis

The survey results were systematically analyzed to discern trends within the responses collected. The subcategories defined for this study are summarized and coded, as illustrated in Table 2, to facilitate detailed discussion and elaboration. The average count of "yes" responses in these subcategories was computed and compared across different respondent groups:

- Which of the following was challenging and uncomfortable in transition to the VLE? (Out of 10)
- Which of these e-learning tools enhanced the teaching experience? (Out of 9)
- What do you think assisted you in the process of moving to VLE? (Out of 10)

Table 2. Code categories and descriptions

Code	Description
A	What do you think assisted you in the process of moving to VLE?
A1	Experience with online education and learning tools.
A2	Institutional support such as clear guidelines, access to high-speed internet, available information technology staff, e-books, and e-service deliveries by different units.
A3	Orientation and training about the online platform by university.
A4	High level of students' participation and commitment to the learning process.
A5	Open and effective means of communication with appropriate tools, e.g. MS Team, Avaya, Zoom, etc.
A6	Collaboration and knowledge sharing activities with local and international institutions.
A7	Family support and cooperation, such as quite space to teach and hold meetings.
A8	Cooperation, collaboration and understanding of colleagues at workplace.
A9	Government support, including funding, high speed internet, free vaccination and PCR.
A10	Institutional leadership support, including effective Covid-19 crisis management, and open door policy.
B	Which of these e-learning tools enhanced the teaching experience?
B1	Online class and laboratory (through Bb Collaborate, MS Team or Skype)
B2	Whiteboard
B3	Video and audio podcasts
B4	E-books and open educational resources
B5	Email
B6	Online discussion forum
B7	Breakout rooms
B8	Assignment feedback
B9	Polling
C	Which of the following was challenging and uncomfortable in transition to the VLE?
C1	Personal and family issues such as loss of job by spouse, COVID-19 related sickness, and inadequate space for online learning activities.
C2	Health issues due to longer hours spent sitting down and remaining at a spot.
C3	Inadequate level of participation and cooperation of students in class activities and grades tasks.
C4	Psychological, wellbeing and mental health problems including apprehension, sense of isolation, insomnia, anxiety, and depression.
C5	Lack of collaboration and knowledge sharing opportunities with local and international institutions.
C6	Outdated teaching and learning resources, including technology and furniture.
C7	Constant technical problems during the online classes, presentations and examinations.
C8	Inadequate support from institutional leadership and line managers, e.g. not willing to give extensions for due assignments, not available for office hour, and non-provision of e-resources.

C9	Insufficient support from the non-academic staff and ineffective service deliveries.
C10	Lack of orientation and training about online learning platforms and their features.
C11	Personal and family issues such as loss of job by spouse, COVID-19 related sickness, and inadequate space for online learning activities.
C12	Health issues due to longer hours spent sitting down and remaining at a spot.

Individual Assessment

The analysis of survey results, detailed in Figures 1 and 2, reveals distinct trends for individual groups and combined demographics. Figure 1 illustrates the influence of gender on the challenges and opportunities associated with transitioning to VLE. Specifically, Figure 1a indicates that females experienced 22.4% more challenges (average score 2.40) compared to males (average score 1.96), which correspondingly led to females utilizing 20.9% more eLearning tools (average score 4.91) than males (average score 4.06).

Furthermore, the data suggest a correlation between age, years of experience, and the adoption of eLearning tools. As shown in Figure 1b, the adoption rates and the number of factors facilitating the transition to VLE increase with age and years of experience, peaking within the 45-54 age group and the 11-15 years of experience bracket. After these peaks, both measures start to decline, potentially due to increased resistance to new teaching methods among older faculty and those with more than 21 years of experience.

Lastly, the impact of the teaching field on the challenges faced, the number of eLearning tools used, and the ease of transition to VLE was minimal, as illustrated in Figure 1c. This suggests that while personal and experiential factors significantly influence the adaptation to VLE, disciplinary differences are less impactful.

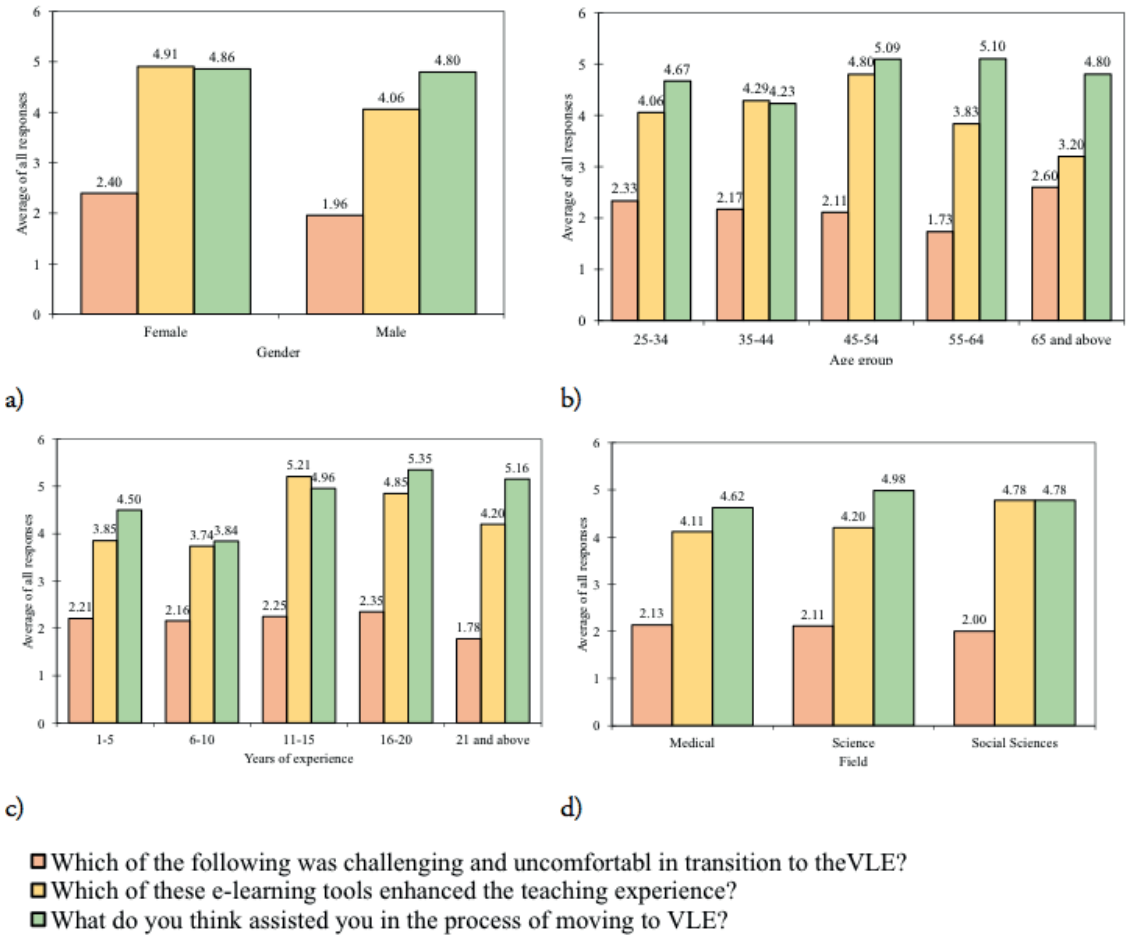

Figure 1. Average responses on number of challenges and opportunities in transferring to VLE in terms of a) gender, b) age group, c) years of experience, and d) field, individually

Combined Assessment

The combined effects of demographic groups on the adoption and utilization of eLearning tools in VLEs are presented in Figure 2. This analysis explores the interplay between gender, years of experience, and field orientation. Figure 2a highlights those females consistently exhibit a higher adoption rate of eLearning tools across all years of experience, particularly beyond six years, with a noticeable peak at 11-15 years. Additionally, females with 11-15 years of experience also utilized a greater number of assisted tools in the VLE transition.

In terms of the relationship between gender and field orientation shown in Figure 2b, it appears that the field itself does not significantly influence the assisted tools or the challenges experienced during the transition to VLE. Notably, males in the social sciences reported approximately 30% fewer challenges compared to their counterparts in other fields, both male and female. However, there are distinct differences within the female group based on field orientation; females in the social sciences adopted eLearning tools at rates 7.5% and 46.1% higher than those in the science and medical fields, respectively. This trend may be attributed to the increased necessity for diverse e-communication tools to effectively replicate interpersonal interactions and socialization inherent in teaching social science-related courses.

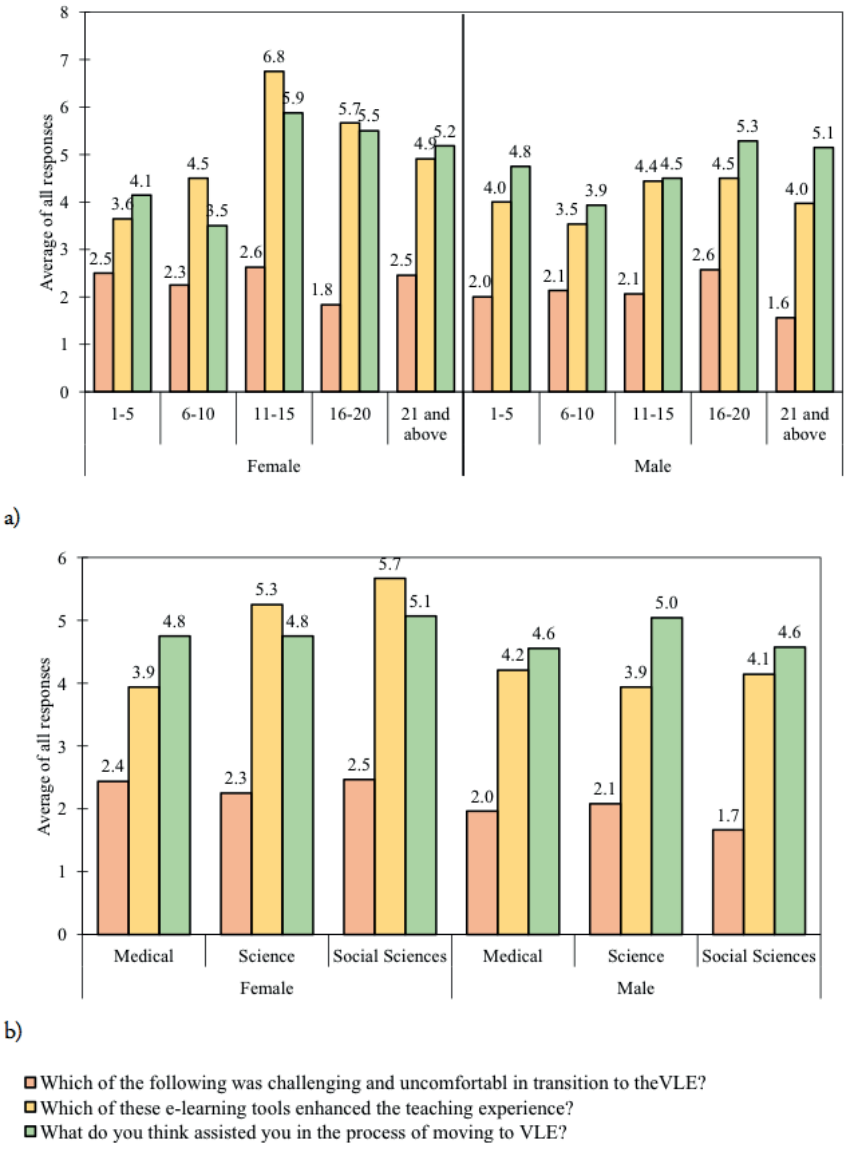

Figure 2. Average responses on number of challenges and opportunities in transferring to VLE in terms of combination between gender and: a) years of experience, and b) field.

Detailed Frequency Analysis

From the analysis presented in Figures 1 and 2, further examination was conducted to understand the relationship between the use of eLearning tools and the ease of transition to VLEs. The average responses regarding the enhancement of the teaching experience by eLearning tools and the assistance provided in transitioning to VLEs were collated and displayed in Figure 3. This figure shows a relatively strong linear correlation between these two variables, with a squared correlation coefficient (R^2) of 0.7699. This substantial correlation indicates that a higher adoption of eLearning tools is likely to significantly enhance the factors that facilitate the transition to VLE, suggesting that investing in eLearning technologies can be crucial in smoothing the transition process and improving the overall teaching experience.

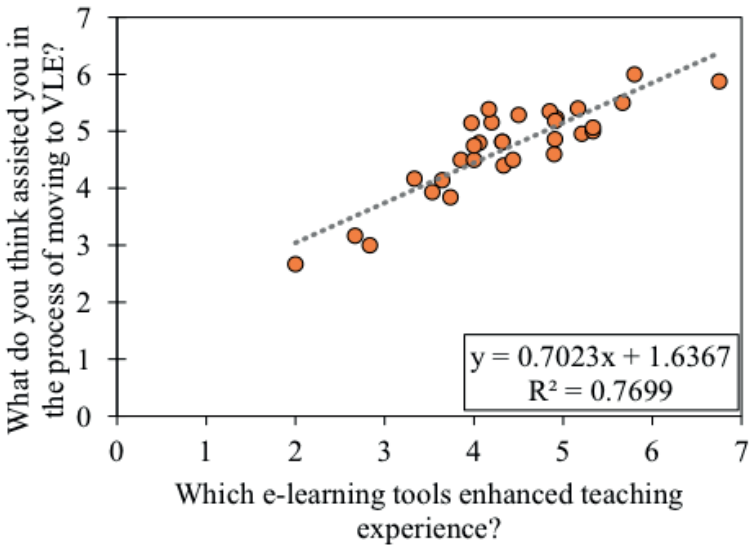

Figure 3. Correlation between number of eLearning tools and assistance in transformation process to VLE

Furthermore, the survey explored faculty preferences for various teaching methods both during and post the COVID-19 pandemic, with the findings succinctly represented in Figure 4. This figure contrasts the preferences during (left side) and after (right side) the pandemic. During the pandemic, the least favored teaching method was face-to-face, at only 12%, while blended teaching was the most preferred, at 35%. Post-pandemic, preference for face-to-face teaching increased to 24%, and preference for the blended mode decreased slightly to 27%. Notably, much of the increase in face-to-face preference post-pandemic was shifted from hybrid-flexible (8.5%) and blended modes (7.0%).

Moreover, the preference for fully online teaching dropped to 12% post-pandemic from 27% during the pandemic, with significant transitions to blended and hybrid-flexible modes. These results indicate a clear preference among faculty members for hybrid-flexible and blended teaching modes over strictly face-to-face or fully online methods, both during and after the pandemic. This suggests that the faculty values the flexibility and the combination of online and in-person elements that these modes offer.

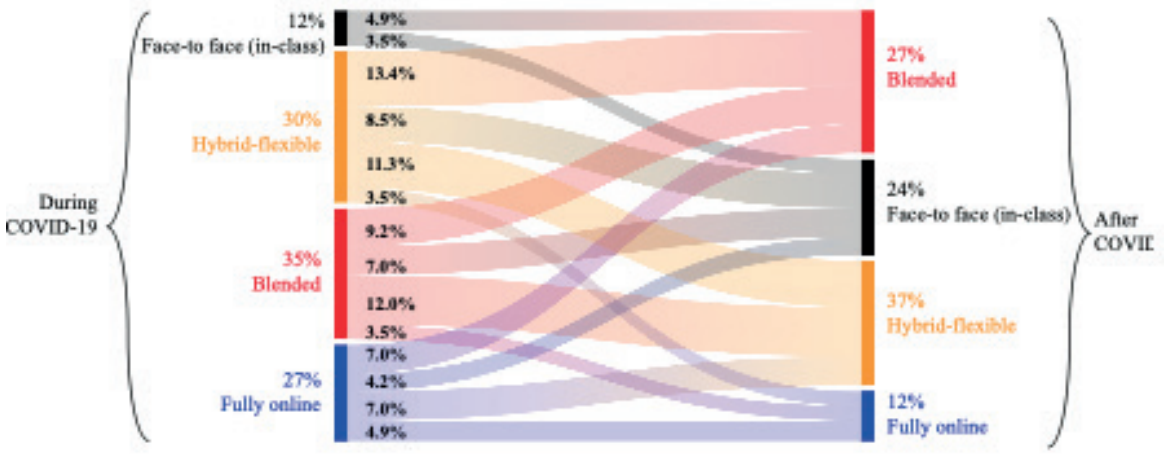

Figure 4. Preference of teaching mode during and after COVID-19

Validity of Collected Responses

The reliability of the current survey data was assessed by calculating Cronbach's alpha (α), a measure of internal consistency, for the survey responses. The analysis yielded an average alpha value of 0.82, indicating a relatively high level of reliability. To further evaluate the robustness of the survey's components, a series of item elimination tests were conducted. Each item was sequentially removed from the dataset, and Cronbach's alpha was recalculated for each modified dataset. The results demonstrated that the overall alpha value was not significantly impacted by the removal of any single item, suggesting a consistent correlation among the survey responses. The lowest alpha value recorded was 0.73, which occurred upon the elimination of item B6, "Online discussion forum." This suggests that while the item contributes to the overall consistency, its impact is not critical to the integrity of the survey's reliability.

General SEM Model Development

The validity and reliability processes in data collection and analyses should be described sufficiently. A Structural Equation Modeling (SEM) approach was employed to analyze the factors influencing the transition to VLEs, as depicted in Figure 3. The SEM model was designed to include multiple interconnected nodes, representing the variables to underscore the interrelated effects among them. Additionally, the subcategories listed in Table 1 were linked to their respective main variables within the model. This setup facilitated a comprehensive analysis of both direct and indirect relationships, providing a nuanced understanding of how various factors collectively impact the transition process to VLE.

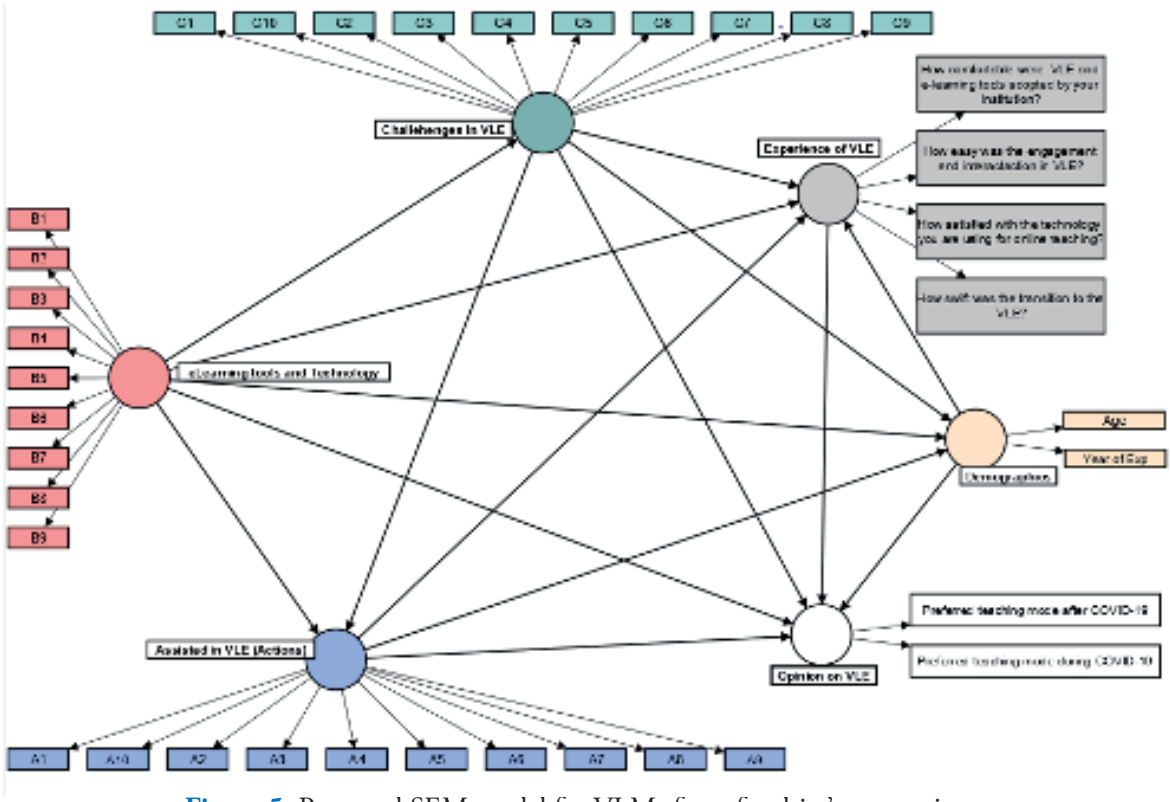

Figure 5. Proposed SEM model for VLMs from faculties' perspectives

Results of the Whole SEM Model

The validity and reliability processes in data collection and analyses should be described sufficiently. The comprehensive analysis of the SEM for the transition to VLEs incorporated all collected responses, along with a focused examination of categorical variables such as gender and field. The summarized results of this comprehensive SEM analysis are presented in Figure 6, where the significance of the relationships is indicated by t-values marked on the paths (arrows) between variables. The line thickness on these paths visually represents the t-value; thicker lines denote higher t-values, indicating stronger effects within the model.

The model demonstrates a strong correlation between the use of eLearning tools and assisted actions in VLE, with a notably high t-value, reinforcing the correlation observed in Figure 3. This strong linkage validates the underlying assumptions of the developed model, confirming its robustness in reflecting the dynamics of eLearning adoption. Moreover, the analysis highlighted several significant relationships highlighted as follows:

- The highest impact observed was from experience in VLE affecting opinions about VLE, with a t-value of 3.560.
- The influence of enabling conditions on VLE experiences recorded a t-value of 2.196, indicating a substantial positive effect.
- The effect of tools that enhance the VLE experience on enabling conditions showed a t-value of 1.867.
- Finally, challenging factors impacting VLE experience had the lowest among the noted significant effects, with a t-value of 1.080.

These results underline the complexity and interdependency of factors that influence the successful implementation and perception of VLE, highlighting the importance of both experiential and enabling factors in shaping effective VLEs.

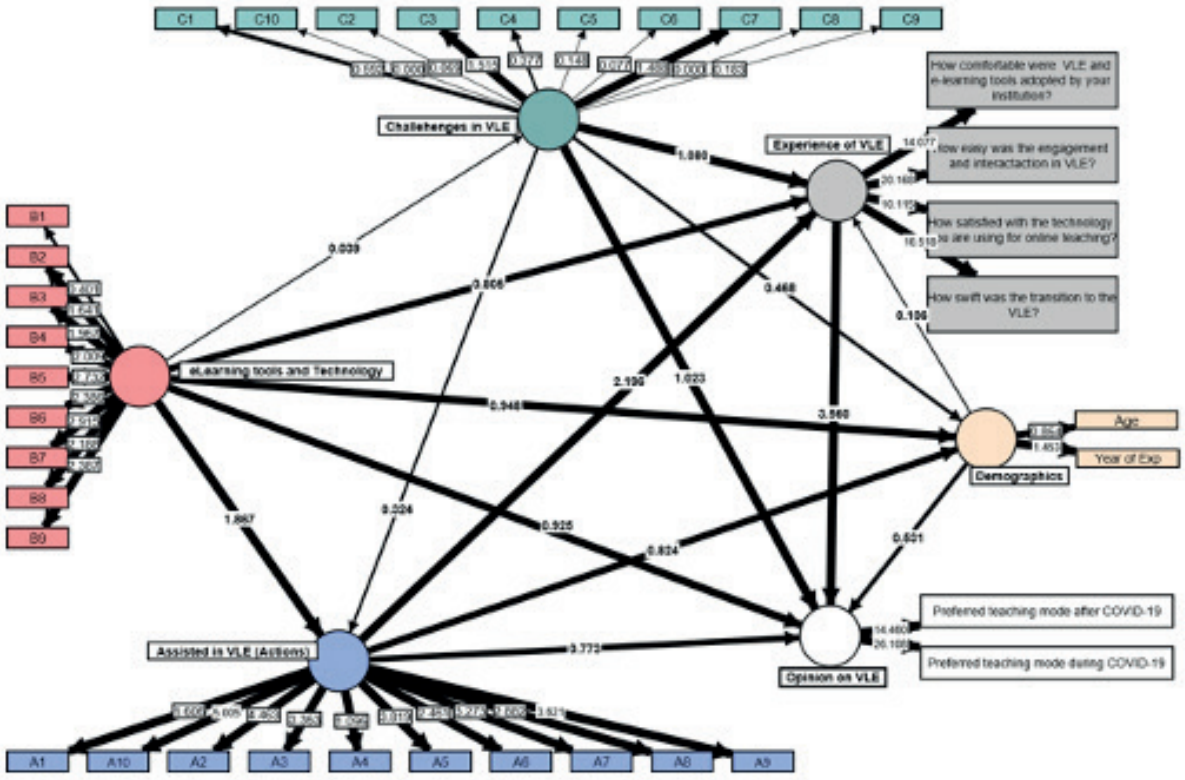

Figure 6. Results of the full SEM model regarding VLMs

Effect of Gender and Field

The SEM model was redeveloped by analyzing the responses of specific demographic groups, including females, males, and individuals from social science, science, and medical fields separately. The t-values representing the effects of each variable within these groups are summarized in Table 3, with colors ranging from green (indicating higher impact) to red (indicating lower impact).

Across all groups, the analysis consistently revealed that "Experience of VLE" had the most significant effect on "Opinion on VLE." However, noteworthy variations were observed among different groups:

- Females and individuals affiliated with the sciences demonstrated higher t-values of 2.861 and 2.283, respectively, indicating a stronger impact of "Experience of VLE" on "Opinion on VLE." In contrast, those affiliated with social sciences exhibited the lowest t-value of 1.032 for this relationship.
- For the relationship between "Assisted in VLE (Actions)" and "Opinion on VLE" and "Experience of VLE," the highest t-values were observed in the female and science models. This suggests that the teaching method selection for females is significantly influenced by "Assisted in VLE (Actions)" and "Experience of VLE."
- In contrast, for the male gender, "Experience of VLE" and demographic factors had the highest impact on "VLE Experience."

Furthermore, the results indicate that challenges in VLE have a significant impact on assisted VLE actions in the medical field. Unlike other fields and gender groups, individuals in the medical field tend not to recognize assisted VLE actions (such as fast internet connections and availability of technology staff) when faced with challenges in VLE. This highlights the unique challenges and perceptions within the medical field compared to other disciplines and gender groups.

Table 3. t-values for all groups (genders and college orientations) in SEM

Relation	t-value				
	Gender		College orientation		
	Female	Male	Medical	Science	Social Science
Assisted in VLE (Actions) → Demographics	0.952	0.625	0.169	1.055	0.62
Assisted in VLE (Actions) → Experience of VLE	2.036	0.546	0.686	2.205	0.02
Assisted in VLE (Actions) → Opinion on VLE	2.223	0.687	1.16	0.016	1.096
Challenges in VLE → Assisted in VLE (Actions)	0.1	1.416	1.432	0.714	0.33
Challenges in VLE → Demographics	0.19	1.357	0.501	0.6	1.397
Challenges in VLE → Experience of VLE	1.02	0.824	0.011	0.96	1.05
Challenges in VLE → Opinion on VLE	1.004	1.099	0.925	0.878	0.688
Demographics → Experience of VLE	0.182	1.635	1.076	0.22	0.231
Demographics → Opinion on VLE	1.048	0.141	0.053	0.377	0.691
Experience of VLE → Opinion on VLE	2.861	1.944	1.435	2.283	1.032
eLearning tools and Technology → Assisted in VLE (Actions)	1.385	1.094	0.448	0.854	1.076
eLearning tools and Technology → Challenges in VLE	0.421	0.891	0.46	0.706	0.421
eLearning tools and Technology → Demographics	0.598	1.401	0.197	0.782	0.251
eLearning tools and Technology → Experience of VLE	0.061	0.132	1.153	0.676	0.888
eLearning tools and Technology → Opinion on VLE	0.184	1.36	0.416	0.745	1.119

Qualitative Data

Issues and Challenges Experienced While Teaching on VLE Platforms

The qualitative data analysis highlighted two major themes that encapsulate the challenges faculty members faced while teaching using VLE platforms and tools during the pandemic. These themes, along with their supporting codes, are outlined in Table 4.

Table 4. Challenges experienced by faculty on VLE in an emergency

S/N	Themes	Codes
1	Engagement and Interaction issues	Online teaching has no soul, face to face make me vibrant, active, motivated. Online teaching kills interaction.
		Always very hard to monitor students' activities during the lectures and labs. Students are not getting involved. Students were less attentive with closed cameras and constant excuses such as "got disconnected" or "no internet", when in reality they were in a public venue attending an online class.
2	Hard and software issues	Network is constantly disconnected even using from home or university office.
		Frequent internet outages and disturbances particularly during exams as claimed by many students but lack of evidence to support to their case.
		Unfortunately University supplied faculty with worst quality laptops that are not suitable at all for online learning.

Reasons for the Choice of Teaching and Learning Mode

As previously discussed in the quantitative section, faculty members expressed their preferences for various teaching and learning modes. Table 5 summarizes the prevalent opinions of faculty regarding their chosen teaching and learning modes, as derived from the qualitative data.

Table 5. Key reasons for the choice of teaching and learning mode by faculty

S/N	Teaching Mode	Codes
1	Fully Online	For giving the opportunity to learn to everyone, everywhere and under any circumstances.
		Online is good for lectures and others such as seminars which can be convenient for some people.
		The future is online, it has to keep the old version traditional and well-worked system and built a new one.
2	Blended	Because in this method I can teach online and apply all online activities and at the same time I can bring my students to the lab, communicate with them and allow them to use the devices in the lab.
		We need to make full use of all the platforms and tools we have available to us. Face-to-face learning is the best but it needs to be complemented with online tools for more efficient and flexible teaching and learning.
		Many students struggle to arrive on campus, so reducing the amount of face-to-face classes maybe more beneficial and flexible for any concurrent student commitments.
3	Hybrid-Flexible	After the pandemic is over, I still recommend hybrid flexible learning ... especially for Postgraduate students. It's very suitable for them and may result in increasing the students' enrollment in post-graduate studies.
		Hybrid learning is more adaptive and flexible. Faculty members can choose the method based on the students' needs and learning objectives.
		The Hybrid-flexible learning with the opportunity to attend class in person or join online based on personal needs and situations, is a good approach, but it requires (1) dedicated students, (2) robust cheating rules, and (3) sincere leadership.
4	Face-to-Face	The personal touch, the eye contact, student-to-student interaction, this is what teaches students not the reciting of information over a distant screen
		Better interaction and one on one communication. Loopholes can be identified easily with constant student-faculty interaction. Can keep a track of the learning process by adopting multiple formal and informal assessment tools.
		Because the university education is not only about facilitating knowledge, student should interact personally with each other and with their faculties, and through being on campus would enhance student personality and professionalism

Measures for Improving the Teaching and Learning Process in VLE Context

The faculty overwhelmingly concurred that specific measures are necessary to improve the teaching and learning process through VLEs during emergencies. Analysis of the qualitative data revealed five principal themes, which are detailed in Table 6 along with the corresponding supporting codes.

Table 6. Faculty views on measures required to enhance the teaching and learning process in emergencies

S/N	Theme	Codes
1	Training	Faculty development programs on how to improve teaching and learning in the virtual environment, including frequent updates and training on available tools/applications.
		All academic staff should attend training on essential educational technologies and demonstrate competency in using these.
		Capacity building for staff, faculties and students
2	Policies	Policies at a higher level should hold students accountable.
		Change of educational policies. Insistence on the student turning on both camera and microphone. Taking attendance automatically and barring students who exceed the absence limit.
		New policies to encourage hybrid or online mode… robust cheating rules.

3	Moderate teaching load	Reduce the load and have reasonable expectations.
		Class size must be kept within reasonable limits.
		Classroom capacities need to be reduced.
4	Technology Infrastructure	Accessibility to technology (computers/internet) are key. Perhaps institutes can think about providing/loaning tablets to students. Special government subsidies for students learning in hybrid mode? Essentially ease of access is important to make hybrid-flexible a successful mode.
		Pay more attention for IT infrastructure including servers, Internet speed and bandwidth, adopt Smart Campus techniques (eco-system).
		Care must be taken to regularly update the learning software to keep pace with technical developments
5	Innovative and creative teaching methods: Blended and Hybrid-Flexible	Recognize that the new teaching & learning delivery methods require far more effort on the part of the faculty.
		We need to continue making full use of all the platforms and tools we have available to us. Academic institutions spent so much resources to train faculty to use the online tools, it would be a waste to just go back to traditional face-to-face teaching.
		Revisions should be made to the study plans and syllabi in line with the methods of hybrid and distance education.

DISCUSSIONS

This study investigated the factors facilitating or impeding faculty's rapid adoption of VLEs during the COVID-19 pandemic in the UAE, highlighting the importance of understanding these elements to lead effective institutional change. Our quantitative analysis revealed distinct trends in the challenges and facilitators of transitioning to VLEs, as illustrated in Figures 1 and 2. These findings underscore the significance of technology acceptance, as outlined in the Technology Acceptance Model (TAM) framework, which emphasizes the perceived ease of use and benefits in adopting new technologies (Davis, 1989). Table 2 elucidates faculty preferences for different teaching modes, emphasizing the need for flexibility and adaptability. The preference for fully online modes was driven by the desire to make learning accessible to everyone, everywhere, aligning with the TAM framework's focus on perceived benefits (Davis, 1989). Blended and hybrid-flexible modes were favored for their ability to combine online and face-to-face interactions, enhancing both engagement and practical application. These preferences reflect the evolving landscape of educational delivery methods and the necessity for multifaceted approaches (Aderibigbe et al., 2023a; Yilmaz et al., 2022; Gillett-Swan, 2017).

Qualitative data from Table 1 highlight several key challenges faced by faculty during the emergency transition to VLEs. Engagement and interaction issues were predominant, with faculty expressing that online teaching lacks the vibrancy and motivation of face-to-face interactions. This aligns with our quantitative findings and supports existing literature on reduced engagement in online environments (Li et al., 2023; Luebstorf et al., 2023; Gasmalla et al., 2022). Faculty also reported difficulties in monitoring student activities and maintaining attentiveness, compounded by students' excuses about technical issues. Additionally, hardware and software issues significantly impacted the effectiveness of VLEs. Frequent network disconnections and the poor quality of university-supplied laptops hindered the teaching process, reflecting broader infrastructural challenges documented in previous studies (Shambour et al., 2022; Khan, 2021).

Our SEM results reveal both alignment and divergence from prior research, illustrating unique contextual factors within the UAE. Notably, female faculty members reported greater challenges in adapting to VLEs, supporting research that suggests gender differences in technology adoption and adaptation (Bawaneh & Malkawi, 2023; Dinu et al., 2022; Shambour et al., 2022; Khan, 2021). Additionally, the higher engagement of females with e-learning tools echoes findings that highlight the value placed on communication and collaboration tools in online learning environments by women (Tinmaz & Lee, 2020; Luppicini & Walabe, 2021). Addressing these gender-specific challenges is essential, and strategies such as fostering a Community of Inquiry (COI) can facilitate social, cognitive, and pedagogical transformation (Garrison et al., 2000). Our analysis also explored the impact of age and experience on VLE adoption. We observed a peak in e-learning tool adoption and support in the transition process up to a certain age, after which resistance to

new teaching methods became more prevalent. This trend corroborates studies suggesting slower technology adoption rates among older and more experienced faculty members (Hradecky et al., 2022; Shambour et al., 2022; Treve, 2021; Liu et al., 2020). However, other research contradicts this, arguing that age and experience do not necessarily impede technological integration in education (Blackwell et al., 2013). The influence of the teaching discipline on the adoption of VLEs was less pronounced, aligning with research indicating consistent challenges and benefits across disciplines (Aderibigbe et al., 2023b, Almaiah et al., 2022; Conrad et al., 2022; Elshami et al., 2022). Nevertheless, contrasting findings highlight the distinct needs and requirements of different academic fields, underscoring the importance of a discipline-sensitive approach as suggested by the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006).

Table 3 provides insights into the measures faculty believe are necessary to improve VLEs. Training and capacity building were deemed essential for effective online teaching, underscoring the need for continuous professional development in educational technologies. This is consistent with the COI framework, which emphasizes the importance of social, cognitive, and teaching presence in online learning environments (Garrison et al., 2000). Policy changes, such as enforcing attendance and deterring cheating, were also highlighted as crucial. These suggestions reflect the need for robust institutional policies to support VLEs, aligning with findings on the importance of structured environments in online education (Tinmaz & Lee, 2020; Luppicini & Walabe, 2021). The need for moderate teaching loads and enhanced technology infrastructure was emphasized to ensure a sustainable and effective VLE environment. Faculty called for improved IT infrastructure, smaller class sizes, and updated learning software, echoing concerns about the adequacy of technological support (Almaiah et al., 2022; Conrad et al., 2022).

Linking these findings to emergency situations, such as the rare but impactful floods in the UAE, underscores the necessity of VLEs. Just as VLEs were pivotal during the pandemic, their utility during unexpected natural disasters cannot be overstated. They ensure continuity of education when physical attendance is disrupted. This parallels the need for robust e-learning tools and strategies that can quickly adapt to various emergencies, reinforcing the principles of the activity theory and diffusion of innovations theory, which emphasize proactive engagement and flexible adaptation (Engestrom, 1987; Rogers, 1995). While our study aligns with much of the existing literature, the unique challenges and opportunities presented by emergency situations like floods in the UAE highlight the need for context-specific analyses and adaptable educational technologies. These findings advocate for nuanced, flexible approaches to the implementation and enhancement of VLEs across varied and evolving educational landscapes.

CONCLUSION

This study highlights that faculty members can effectively transition to VLEs and other technology-enhanced educational platforms during crises to ensure the continuity of teaching and learning. The ease and success of this transition are influenced by various enabling and hindering factors. Consequently, institutional leadership must actively work to minimize obstacles and bolster conditions that facilitate an effective faculty transition, tailored to diverse demographic needs, including gender, age, and disciplinary fields.

In regions prone to emergencies such as pandemics and floods, as experienced in the UAE, the robustness of technological infrastructure and institutional support becomes even more critical. To ensure a seamless and effective transition to VLEs in challenging and unpredictable circumstances, institutions could consider the following strategies:

- Boosting Institutions' Technological Support - Enhancing the technological framework is essential, not only updating hardware and software but also providing extensive IT support accessible to all participants in the learning environment. Establishing a rapid-response IT team can ensure smooth operations in virtual classrooms.
- Formulating and Explicitly Communicating Policies - Developing transparent, explicit, and enforceable policies that govern student responsibilities, attendance, and anti-cheating measures is indispensable. For policies to be adequately understood and applied, regular workshops should be conducted to familiarize everyone with these policies. Furthermore, the policies should be regularly

reviewed and adapted to meet evolving educational and technological needs.

- Adopting Flexible Instructional Approaches - Institutions might consider an intentional blend of online and physical teaching elements to support diverse learning preferences. Providing asynchronous learning options can accommodate students in different time zones and with varying schedules, allowing them to engage with content at their convenience.
- Ongoing Monitoring and Improvement - Regularly assessing the technological tools and infrastructure deployed is critical for identifying and resolving issues proactively. Collecting and analyzing feedback from educators and learners will help refine the tools and strategies, ensuring they effectively meet educational goals.
- Continual Professional Growth - Committing to the continuous professional development of teaching staff is crucial. Institutions should priotise training in the latest educational technologies and instructional strategies, enhancing the effectiveness of virtual learning through updated teaching methods and tools.

Lastly, there is a crucial need for further large-scale, nationwide, and longitudinal research to delve into additional factors that influence faculty members' transition to VLEs during emergencies such as pandemics and floods, particularly within the context of the UAE. Such research should aim to uncover deeper insights into the dynamics of faculty adaptation and resilience in face of these challenges. This approach will not only refine and improve current educational practices but also strategically prepare educational institutions to tackle future challenges more effectively. This proactive stance is vital for ensuring the continuity and quality of education in unpredictable scenarios, contributing significantly to the robustness and adaptability of HEIs.

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CONFIGURING VIDEO-BASED LEARNING AND ONLINE LEARNING EXPERIENCE TO SHAPE STUDENTS' SATISFACTION

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ABSTRACT

Universities value student satisfaction with online learning techniques because it implies achievement. Additionally, teachers' use of ICT to boost student satisfaction should be examined. There is a limited amount of research on how video content in video-based learning and online learning experiences can improve student satisfaction as part of online learning strategy formulation. This study uses video content (understandability, reliability, and quality) in video-based and online learning to predict student satisfaction and test hypotheses and proposition using PLS-SEM and fs-QCA on 190 Indonesian university students who have taken online courses. The SEM analysis shows that online learning is the primary determinant of student satisfaction. Video content must be considered by teachers to boost online learning. Simultaneously, the online learning experience mediates content understandability and student satisfaction. The fs-QCA results offer both theoretical and practical insights that enable institutions to assess the degrees of satisfaction among students, distinguishing between those with high and low levels. Content understandability, reliability, and quality contribute to a high level of student satisfaction. Conversely, the absence of comprehensibility, excellence, and a satisfactory online learning encounter leads to diminished levels of contentment. The discoveries will assist establishments in enhancing the online educational encounter, thus impacting students' satisfaction.

Keywords: Video-based learning, online learning, students' satisfaction, fs-QCA, SEM.

INTRODUCTION

Online learning has evolved and is expanding globally due to the successful integration of information and communication technologies into educational practices (Tkachuk et al., 2021). This technological advancement has led to a significant transformation in university, shifting from traditional in-person classes to more flexible online education models (Muller & Mildenberger, 2021). The integration of these technologies has fundamentally enhanced the learning process, offering greater accessibility and adaptability to diverse learning needs (Mushtaha et al., 2022). Educational activities, including lectures, discussions, and collaborative projects, have increasingly utilized digital platforms (Fehrman & Watson, 2021; Lange &

Costley, 2020; Vahed & Rodriguez, 2021). However, the transition to online learning has not been uniform, with disparities in technological infrastructure (Ferri et al., 2020) and digital technology adoption (Rahmadi, 2021) posing challenges in some regions . Despite these obstacles, government initiatives and continuous technological improvements have facilitated the adaptation of educational systems to online environments. This shift has ensured the continuity of education and introduced innovative teaching methodologies, enriching the overall educational experience (Riaz et al., 2023). Consequently, online learning has become a vital component of modern education, providing new opportunities for both learners and educators to engage in dynamic and interactive learning experiences.

Universities worldwide have utilized online learning to replace traditional methods in order to assure the continuation of education (Riaz et al., 2023). Online learning has shown to be a valuable resource for educators and students, transcending limitations of distance and time (Openo, 2020). Nevertheless, the online learning process is not devoid of issues. Currently, numerous students are still facing challenges in accessing high-quality online education (Alamri, 2023). Furthermore, many lecturers fail to see that online learning serves not only as a substitute for classroom learning but also as a distinct learning environment in cyberspace. Lecturers believe that teaching and learning online simply involves transferring educational materials from physical classrooms to virtual environments. The internet has the ability to offer several benefits through information and communication technologies, including online discussion, educational assistance videos, and virtual exmination (Elzainy et al., 2020; Sablic et al., 2021; Wei & Chou, 2020). Therefore, students can have heightened learning satisfaction through online learning (Muzammil et al., 2021).

The use of video content to increase satisfaction has been widely researched (Cao et al., 2021; Lin et al., 2023; Lou & Xie, 2021). However, this research focuses on the marketing sector, such as the use of video content on social media to attract attention and provide satisfaction to customers (Lou & Xie, 2021). Research on video-based learning to enhance students' satisfaction, particularly in online education, is still scarce. Video-based learning involves incorporating video content into the educational process using information and communication technology and offers a unique experience. Shin & Park (2021) propose that video content has an impact on customer satisfaction. The findings indicate that content quality of the video leads to higher consumer satisfaction. Additional studies indicate that users experience satisfaction when video information is deemed reliable. When video content is perceived as easy to understand, it enhances user engagement and satisfaction (Munaro et al., 2021). Despite universities promoting the integration of information and communication technology in education, the advantages and significance of online learning experiences have not been fully recognized, and student satisfaction expectations have not been met. This necessitates the execution of continuous study inquiries into the aspects that precede the enhancement of student satisfaction. Universities should motivate lecturers to enhance the precision, effectiveness, and interest of online learning.

The objective of this study is to examine the impact of the content of video-based learning and online learning experiences on students' satisfaction. This study aims to evaluate the implications content video in video-based learning for enhancing online learning experiences and students' satisfaction. Prior research has only focused on analysing the effects of online learning practices on student satisfaction (Abdelrady & Akram, 2022), as well as investigating the influence of video-based learning on student satisfaction (Sablic et al., 2021). However, there has been no research conducted on the combined impact of these two components. Therefore, it is crucial to examine how video material might improve online learning experiences and boost student satisfaction. To the best of our knowledge, no studies have been carried out to examine how video content affects online learning experiences and student satisfaction with their learning, specifically in terms of its understandability, reliability, and quality. This research enhances the current body of knowledge by investigating the relationship between online learning and students' satisfaction.

Furthermore, this study employs a hybrid methodology combining structural equation modeling (SEM) and fuzzy-set qualitative comparative analysis (fs-QCA) to examine how online learning experience and video-based learning content, specifically video content quality, reliability, and understandability, impact student satisfaction. The structural equation modeling (SEM) analysis will examine the causal relationship among exogenous, mediating, and endogenous variables by assessing the validity, reliability, and presented hypotheses. The fs-QCA approach is used to forecast how online learning interactions using video-based learning content, focusing on content quality, reliability, and understandability, as well as online learning

experience can lead to different situations, such as high and low student satisfaction. In this context, "high student satisfaction" reflects a positive result due to the arrangement of external factors, whereas "low student satisfaction" signifies a negative result due to the arrangement of the external construct. This research not only delves into theoretical analysis of high and low student satisfaction predictions but also offers practical consequences for universities and lecturers. This study provides significant insights for universities and lecturers on how to utilize video-based learning content in online learning to enhance students' satisfaction. Utilizing video-based learning content in online learning can either stimulate positive experience as well as students' satisfaction or reveal factors that could diminish it. This enhances the theoretical framework and practical approaches for universities and professors through the use of new technology and a more profound comprehension of student behavior in the digital age.

LITERATURE REVIEW, HYPOTHESIS, AND PROPOSITION DEVELOPMENT

Online Learning Experience and Students' Satisfaction

Online learning refers to formal and informal learning activities that use information and communication technology to address physical and psychological distance issues, while enhancing interaction and communication between students and teachers (Mathrani et al., 2022). The quality of content or material communication in online learning is crucial when leveraging information and communication technologies.

According to Lorenzo & Moore (2002), a quality framework in online learning systems consists of five key elements: student satisfaction, effectiveness of learning, faculty satisfaction, student access, and institutional cost effectiveness. Additionally, key factors contributing to the effectiveness of online learning include the utilization of information technology, robust student-teacher interaction, high-quality learning materials, and faculty assistance (Gunasinghe et al., 2020). Therefore, the quality of online learning is strongly linked to student satisfaction.

Multiple sources indicate that online learning is more effective than traditional learning in enhancing students' knowledge, competencies, and satisfaction with the learning process (Landrum et al., 2021; Mok et al., 2021; Yu, 2021). Abdelrady & Akram (2022) claimed that incorporating technology and information communication in education makes it easier for pupils to obtain information, leading to increased satisfaction. Muzammil et al., (2021) examines the correlation between student contentment and online education. The research highlighted that online learning allows students the autonomy to delve into the content and facilitates increased interactive engagement with the teacher. However, teachers have not yet generally adopted this method in online education with their students. Teachers employ information and communication technology as a learning tool but do not fully use its possibilities (Jin et al., 2021). In other words, teachers use information and communication technology yet still employ traditional teaching methods. Several studies have demonstrated that online learning can enhance student satisfaction through increased online contact, communication, active learning, improved digital literacy, and the use of video-based learning (Bailey et al., 2021; Wong et al., 2022; Yu, 2022). Thus, universities must be capable of employing online learning to enhance students' satisfaction with online learning. Thus, we suggest the following hypothesis:

H1: Online learning experiences positively impacts students' satisfaction.

Content Video in Video-Based Learning and Online Learning Experience

Video-based learning is a concept that uses video content to enhance online learning experience (Sablic et al., 2021). Video-based learning facilitates interaction between students and teachers by utilizing video content to enhance the online learning experience (Ashour et al., 2023; Roman-Sanchez et al., 2023). Therefore, video-based learning has become a dynamic online tool for addressing technical issues due to technological advancements.

Video content is commonly utilized in marketing through information and communication Technologies (Mulier et al., 2021; Romero-Rodriguez & Castillo-Abdul, 2023; Tafesse, 2020; Zhang et al., 2020). Mathew & Soliman, (2021) specifically uses video content for tourism promotion. Research on the use of video content for visual interaction among users through shared videos has been extensively explored in marketing

but is not commonly seen in the education field, particularly in online learning (Andonova et al., 2023). Regarding video content, three key characteristics associated with video-based learning to enhance user interaction are understandability, reliability, and quality. Content understandability is the degree to which video content is easily comprehensible to users (Xu & Chen, 2006). Content reliability is determined by the degree to which people perceive the content as being true, trustworthy, and accurate (Xu & Chen, 2006). Meanwhile, content quality refers to the level at which users perceive the excellence of the information provided, impacting their attitudes (Xu & Chen, 2006). Hence, these three features are believed to impact user behavior and determine whether viewers experience satisfaction with the video content offered.

Various studies demonstrate that the comprehensibility of content has the power to enhance the user experience (Malakul & Park, 2023). Govers et al., (2007) disclosed that people exhibit attitudes towards video content when they see the information presented in the content as comprehensible. Complex or confusing information can cause users to feel uncertain, leading to a prolonged process of understanding and interpreting the context of video content (Zheng et al., 2017). Users may need to exert extra effort to decipher the meaning of the video. Consequently, if users struggle to comprehend the information sent in the video, they may choose to disregard the content altogether. Prior studies have indicated that video content that is easily comprehensible has the capacity to improve students' learning experiences in online educational practices (Malakul & Park, 2023). Thus, we propose the following hypothesis:

H2a: Content understandability in video-based learning positively influence online learning experience.

The reliability of content is contingent upon the video's value and its perceived accuracy by users (Xu & Chen, 2006). Hence, the reliability of content holds significant importance for users. The assessment of the reliability of information relies on an individual's inclination towards the information presented in the video content (Chesney & Su, 2010). Thus, the video should possess the ability to persuade visitors to watch the content being given. Therefore, users' perception of the information's value has a significant impact on their attitude. Empirical evidence has demonstrated a direct correlation between video content and enhanced experiential outcomes (Almusharraf & Khahro, 2020; van der Spoel et al., 2020). Hence, the dependability of video content directly influences the user experience. We propose the following hypothesis:

H2b: Content reliability in video-based learning positively influence online learning experience.

Another crucial factor that influences user experience is the quality of video content (Dabbous & Barakat, 2020). Content quality refers to how well the content meets the user's needs and expectation (Chesney & Su, 2010). Studies indicate that high-quality content impacts an individual's perception when comprehending video content (Kumar et al., 2021). Furthermore, high-quality video content is crucial for users as it facilitates their observation and comprehension of the information delivered, thus impacting user experience (Al-Adwan et al., 2021). On the basis of these consideration, we propose the following hypothesis:

H2c: Content quality in video-based learning positively influence online learning experience.

Mediating Relationship

Online learning experiences as a mediator between content video in video-based learning and student satisfaction. It has been demonstrated that online learning facilitates distance learning by eliminating time and distance restrictions on lecture delivery (Mathrani et al., 2022), thereby increasing student satisfaction (Jiang et al., 2021). Similarly, video content incorporated into video-based learning has afforded students novel opportunities to acquire superior distance learning (Yoon et al., 2021).

Video-based learning is implemented in diverse formats across multiple universities in Indonesia. First, the presenters employ online learning platforms such as Zoom, Microsoft Teams, Google Meets, or Moodle. This platform serves as a medium through which lectures are delivered to substitute the traditional lectures. Conceptually, lectures delivered through online learning platforms are essentially identical to traditional lectures in that they both involve students in person, albeit over the internet, where time and distance are not constraints (Sablic et al., 2021). Students continue to derive benefits from this lecture model due to its interactive nature, which allows for immediate feedback provision (Seo et al., 2021). Furthermore, the lecture model incorporates video content, in which the teachers delivers lectures through video recordings

that are indistinguishable from traditional lectures presented in various media formats (Sablic et al., 2021). Eventually, the lecture model integrates online platform lectures with supporting video content that attendees may obtain as video supplements (Yoon et al., 2021). The content of the supporting video is not required to be identical to that of a traditional lecture. The purpose of this supporting video is to enhance students' comprehension in situations where they are unable to engage in virtual interactions with the instructor or offer feedback on online lectures. In order to effectively impart knowledge to students, instructional videos must feature content that is dependable, credible, and of superior quality (Al-Adwan et al., 2021; Sablic et al., 2021).

The relationship between online learning, video-based learning, and students' satisfaction has been partially demonstrated in numerous studies. When students are granted the opportunity to attend lectures online, it will facilitate their learning when they are unable to physically attend class (Ferri et al., 2020) and offer them new experiences (Maqableh & Alia, 2021) that will contribute to their overall satisfaction (Landrum et al., 2021). Additional research indicates that video-based learning has been demonstrated to enhance student satisfaction by facilitating an effective learning experience (Roman-Sanchez et al., 2023; Sablic et al., 2021). Consequently, the following hypothesis is postulated:

H3a: Online learning experiences positively mediates the nexus between Content Understandability in Video-Based Learning and students' satisfaction.

H3b: Online learning experiences positively mediates the nexus between Content Reliability in Video-Based Learning and students' satisfaction.

H3c: Online learning experiences positively mediates the nexus between Content Quality in Video-Based Learning and students' satisfaction.

The Development of fs-QCA Propositions

The influence of online learning on the attitudes of students has garnered considerable interest (Bovermann & Bastiaens, 2020). In order to provide students with a diverse range of experiences during the online learning process, video-based learning is implemented (Maqableh & Alia, 2021). Video-based learning facilitates the online learning experience through the incorporation of video content (Sablic et al., 2021). Within the realm of video content, video-based learning can be associated with three factors that foster greater user engagement: understandability, reliable, and quality (Al-Adwan et al., 2021; Sablic et al., 2021). Understandability is determined by the degree of simplicity with which the presented information is understood (Malakul & Park, 2023). Reliability is considered to affect user attitudes is the precision of the information comprising (Chesney & Su, 2010). Quality content is identified by the degree to which the narrative conveying the information is both engaging and all-encompassing (Chesney & Su, 2010). These three components have the potential to foster increased students' engagement (Chen et al., 2021), motivation (Lee et al., 2021), and satisfaction (Sablic et al., 2021).

Furthermore, the degree to which online learning fulfills student expectations constitutes student satisfaction with online learning (Landrum et al., 2021). This gratification is the result of fulfilling the online learning requirements of students. Students' expectations for high-quality online learning will be fulfilled when they are provided with dependable, comprehensible, and high-quality instructional videos (Al-Adwan et al., 2021; Sablic et al., 2021). Consequently, this will have an impact on their overall satisfaction level. Therefore, online learning configured with video content in video-based learning plays an important role in determining whether the level of student satisfaction is high or low. Consequently, we hereby present the subsequent propositions (see Figure 2 for asymmetric model of fs-QCA):

Proposition 1: The presence of a single video content in video-based learning configured with online learning experience alone is insufficient to leads to high students' satisfaction.

Proposition 2: The absence of a single video content in video-based learning configured with online learning experience alone is insufficient to leads to low students' satisfaction.

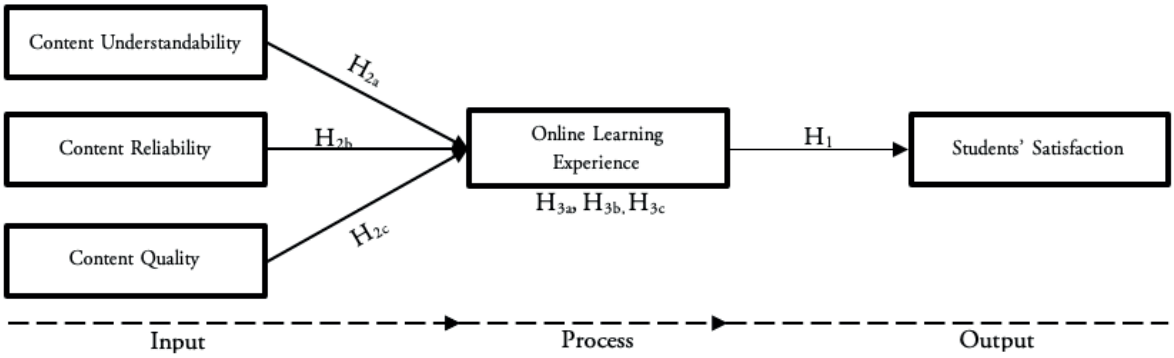

Figure 1. Proposed model to predict students' satisfaction

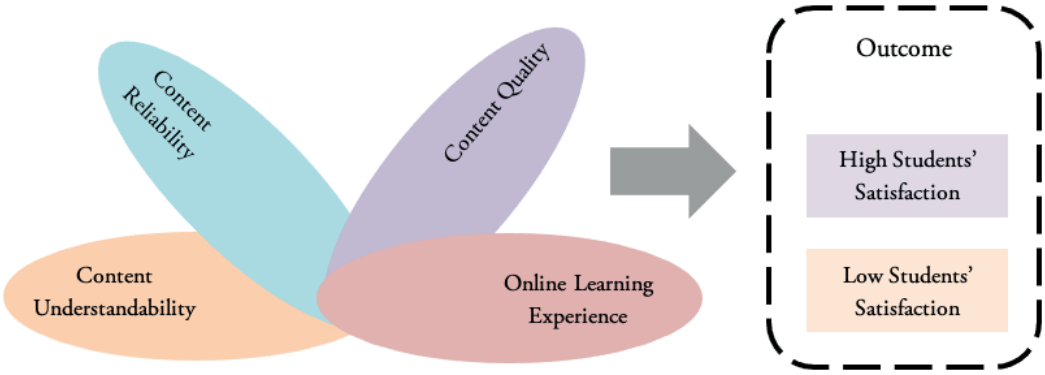

Figure 2. Proposed model for asymmetrical of fs-QCA method

RESEARCH METHODOLOGY

Measurement Instrument

The questionnaire for data collection was designed using a 5-Likert scale, where 1 and 5 corresponded to strongly disagree and strongly agree, respectively. Table 1 shows the comprehensive measurement construct that adapted from prior research. Online learning experience (five items), content understandability (four items), content reliability (four items), content quality (five items), and students' satisfaction (four items). Trials and pre-tests were conducted to validate items, questionnaires were distributed to 50 respondents, and Cronbach's alpha reliability was analyzed. The Cronbach's alpha values for all constructs above 0.8, demonstrating a satisfactory level of dependability in the pilot test.

Table 1. Measurement Items Development

Constructs	Scale's Type	Sources
Content Understandability	5-Likert Scale	(Delone & McLean, 2014; Kim et al., 2009; Liu, 2013)
Content Reliability	5-Likert Scale	(Delone & McLean, 2014; Kim et al., 2009; Liu, 2013)
Content Quality	5-Likert Scale	(Delone & McLean, 2014; Kim et al., 2009; Rai et al., 2002)
Online Learning Experience	5-Likert Scale	(Yousaf et al., 2022)
Students' Satisfaction	5-Likert Scale	(Yousaf et al., 2022)

Sampling and Data Collection

This study was undertaken through the collection of samples from students enrolled in different universities in Indonesia, with the aim of investigating their experiences regarding online learning. In order to obtain the necessary sample, this study implemented purposive sampling as its sampling methodology. Online distribution of the questionnaire was selected to increase the efficiency of data collection. Surveys were disseminated through the WhatsApp platform, utilizing Google Forms, between January and February of 2024. The research specifically focused on students who had engaged in online learning; with a total of 190 participants were included in the sample. Based on the characteristic of demographic, 138 (72.6%) of the participants were female and 52 (27.4%) were male, with an age range of 17–20 years (87.9%); the remaining participants were between the ages of 21 and 24 (12.1%). Conversely, within the age bracket of 25 to 32 years, no participants convened. With regard to online learning experience, the following percentages are as follows: 30.5% (58 participants) have <1 year of experience, 11.1% (21 participants) have >5 years of experience, and 8.9% (17 participants) have a range of 3-5 years of experience in online learning. In addition, an examination of the most frequently utilized online platforms reveals that 93.2% of students employ Zoom, whereas the remaining percentages utilize Microsoft Teams, Google Meet, and Moodle (3.7, 1.6, and 1.6%, respectively). In terms of online learning support devices, desktop computers (0.5%), laptops (10.5%), and smartphones (88.9%) were utilized most frequently by participants. The demographic characteristics are exhaustively detailed in Table 2.

Table 2. Respondent Profile

Characteristic	Items	Frequency	%
Gender	Male	138	72.6
	Female	52	27.4
Age	17 – 20	167	87.9
	21 – 24	23	12.1
	25 – 28	0	0
	29 – 32	0	0
	> 32	0	0
Online Learning Experience	< 1 year	58	30.5
	1 – 3 years	94	49.5
	3 – 5 years	17	8.9
	> 5 years	21	11.1
Online Learning Platform	Zoom	177	93.2
	Google Meet	7	3.7
	Microsoft Teams	3	1.6
	Moodle	3	1.6
Devices	Desktop	1	0.5
	Smartphone	169	88.9
	Tablet	0	0
	Laptop	20	10.5

Analysis Technique

This study employs a hybrid methodology for data analysis. To predict observed outcomes, specifically student satisfaction, these methods are utilized to accomplish research objectives, which include direct evaluation, mediation effects, and comparative analysis of configurations. First, Smart-PLS 3.0 software is utilized in conjunction with structural equation modeling (SEM) in this investigation. The SEM method is implemented through the evaluation of validity and reliability (Hair et al., 2017). More precisely, employing the R-Square criterion to assess the convergent validity, internal consistency, and discriminant validity of the model. Additionally, the SEM method permits researcher to examine hypotheses regarding direct and mediated effects.

Furthermore, the fuzzy-set qualitative comparative analysis (fs-QCA) methodology was implemented utilizing version 4.0 software. This strategy seeks to attain a configuration for developing the optimal solution

in accordance with observations of student satisfaction. The fs-QCA methodology entails the selection of calibrations for the truth table, followed by the prediction of outcomes (Ragin, 2023).

RESULTS

Construct Validity and Reliability

The research commenced by conducting a convergent validity test before evaluating validity and reliability. The convergent validity test findings indicate that the outer loading value exceeds the minimum requirement of 0.70 (Hair et al., 2017). The data used demonstrate good internal consistency and validity as indicated by values of cronbach's alpha and composite reliability (CR) exceeding 0.70 (Hair et al., 2017). Furthermore, the AVE value surpasses 0.50 (Hair et al., 2017), suggesting that the data does not pose issues about convergent validity (see table 2).

The next step in evaluating the validity and reliability is to perform a discriminant validity test on the research model. The Fornell-Larcker criterion test indicates that the Average Variance Extracted (AVE) value surpasses the other values (Henseler et al., 2015). The HTMT method in the discriminant validity test yielded a value <0.85 (Henseler et al., 2015), meeting the suggested level. The data utilized to test this research model demonstrates good discriminant validity. This study utilized a cross-loading matrix assessment to compare the strength of items by examining one construct against another (Henseler et al., 2015). The discriminant validity criteria are displayed in Tables 3–6.

Table 3. Construct Validity and Internal Consistency

Construct	Items	Factor Loading	AVE	CR	Cronbach's Alpha
Content Understandability	CU1	0.931			
	CU2	0.926			
	CU3	0.928	0.851	0.958	0.942
	CU4	0.906			
Content Reliability	CR1	0.872			
	CR2	0.845			
	CR3	0.860	0.738	0.919	0.882
	CR4	0.859			
Content Quality	CQ1	0.842			
	CQ2	0.845			
	CQ3	0.867	0.729	0.931	0.907
	CQ4	0.862			
	CQ5	0.852			
Online Learning Experience	OLE2	0.737			
	OLE3	0.786			
	OLE4	0.792	0.633	0.873	0.908
	OLE5	0.864			
Students' Satisfaction	SS1	0.858			
	SS2	0.872			
	SS3	0.939	0.807	0.943	0.920
	SS4	0.922			

Notes: OLE1 must be eliminated as it fails to meet the required threshold.

Table 4. Discriminant Validity of Fornell-Larcker Criterion

	CU	CR	CQ	OLE	SS
CU	**0.923**				
CR	0.652	**0.859**			
CQ	0.687	0.722	**0.854**		
OLE	0.357	0.269	0.238	**0.796**	
SS	0.571	0.368	0.508	0.536	**0.898**

Note: The AVE square root value is indicated by the bolded and blue highlighted numbers, while the remaining numbers represent the inter-construct correlations.

Table 5. Discriminant Validity of Heterotrait-Monotrait Ratio

	CU	CR	CQ	OLE	SS
CU	-				
CR	0.714	-			
CQ	0.724	0.804	-		
OLE	0.396	0.309	0.265	-	
SS	0.614	0.407	0.556	0.598	-

Table 6. Cross Loading Matrix

	CU	CR	CQ	OLE	SS
CU1	0.931	0.632	0.687	0.315	0.528
CU2	0.926	0.643	0.658	0.228	0.520
CU3	0.928	0.550	0.592	0.592	0.559
CU4	0.906	0.588	0.604	0.604	0.499
CR1	0.611	0.842	0.662	0.250	0.357
CR2	0.524	0.845	0.634	0.183	0.327
CR3	0.543	0.867	0.584	0.188	0.277
CR4	0.556	0.862	0.595	0.290	0.296
CQ1	0.642	0.613	0.852	0.309	0.449
CQ2	0.579	0.584	0.737	0.205	0.390
CQ3	0.558	0.568	0.786	0.153	0.443
CQ4	0.583	0.660	0.792	0.162	0.431
CQ5	0.562	0.655	0.864	0.173	0.451
OLE2	0.211	0.125	0.056	0.737	0.360
OLE3	0.270	0.317	0.275	0.786	0.424
OLE4	0.265	0.200	0.149	0.792	0.310
OLE5	0.362	0.204	0.239	0.864	0.554
SS1	0.478	0.233	0.347	0.539	0.858
SS2	0.555	0.419	0.565	0.356	0.872
SS3	0.497	0.355	0.491	0.483	0.939
SS4	0.524	0.317	0.426	0.541	0.922

Structural Equation Modelling (SEM) Findings

This study examines the direct influence of the online learning experience on student satisfaction, as well as the direct impact of content understandability, content reliability, and content quality in video-based learning on the online learning experience, based on the relationship hypothesis presented in Table 7. The hypothesis analysis results indicate that the direct effect has a p-value < 0.005. This indicates that H1 ($t = 5.028$, $p = 0.000$), H2a ($t = 3.809$, $p = 0.000$), and H2c ($t = 3.345$, $p = 0.001$) are supported, while H2b ($t = 1.950$, $p = 0.052$) does not have a significant effect on student satisfaction. The impact of content reliability on student satisfaction in video-based learning is not significant. In contrast, online learning experiences have the potential to foster heightened levels of student satisfaction. Instructors have the duty to enhance student satisfaction in online learning by providing understandable, reliable, and high-quality content through video-based learning. Moreover, the present study examined the mediating effects of content

understandability, content reliability, and content quality on the association between online learning and student satisfaction. The results presented in Table 7 and Figure 2 demonstrate that H3a (t = 2.861, p = 0.004) represents the mediating role of content understandability in the association between online learning and students' satisfaction. Conversely, H3b (t = 0.792, p = 0.429) and H3b (t = 0.532, p = 0.595) indicate a direct impact of online learning on students' satisfaction. The findings of this study demonstrate that online learning has a positive impact on satisfaction levels, with content understandability playing a mediating role.

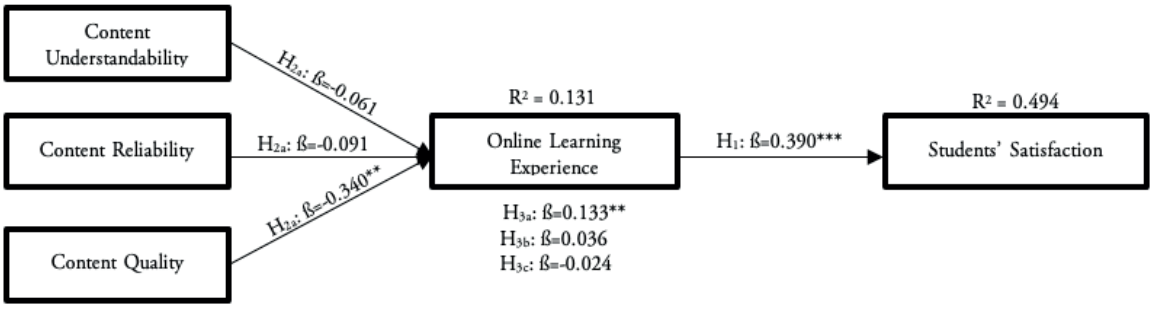

Figure 3. Structural Model Results

Table 7. Hypotheses Result

Causal Relationship	Path Coefficients	t-Value	p-Value	Conclusion
		Direct Relationship		
H_1: OLE → SS	0.390	5.028	0.000	Supported
H_{2a}: CU → OLE	0.340	3.046	0.002	Supported
H_{2b}: CR → OLE	-0.091	0.785	0.433	Unsupported
$H_{2c:}$ CQ → OLE	-0.061	0.127	0.631	Unsupported
		Indirect Relationship		
H_{3a}: CU → OLE → SS	0.133	2.861	0.004	Supported
H_{3b}: CR → OLE → SS	0.036	0.792	0.429	Unsupported
H_{3c}: CQ → OLE → SS	-0.024	0.532	0.595	Unsupported

Fuzzy-Set Qualitative Comparative Analysis (fs-QCA) Findings

Table 10 displays the outcomes of the fsQCA study pertaining to intermediate solutions, encompassing both core and peripheral conditions, with respect to high and low levels of student satisfaction. These results indicate the presence of two configurations that correspond to both "high" levels of student satisfaction and "low" levels of student satisfaction. According to Rihoux & Ragin (2009), it is recommended that the consistency value for a "high" level overall result should exceed 0.75, suggesting a combination of causative factors that is extremely relevant and acceptable. The overall solution consistency value for high student satisfaction results is 0.891, while the overall solution coverage value is 0.893. On the other hand, for "low" student satisfaction results, the overall consistency value is 0.844 and the overall solution coverage value is 0.387. The obtained scores demonstrate improved forecasts for both "high" and "low" levels of student satisfaction in terms of participation outcomes (see Figure 4 and 5). The findings of the fsQCA configuration, as shown in Figures 4, demonstrate a strong correlation and significance between high and low student satisfaction. The configurations results in the state of "presence" represented by symbol *, "absence" represented by the symbol ~, and "do-not-care" represented by blank space. The first solution (HSS) for attaining high levels of student satisfaction outcomes involves the integration of the "presence" condition of *CU, *CR, and *CQ, and the "absence" condition of ~OLE, so supporting the proposition 1. This combination exhibits a consistency value of 0.891 and a coverage of 0.893. The solution demonstrate the impact of content video in video-based learning on student satisfaction and its significance as a predictive factor for student satisfaction. Consequently, the engagement of content video in video-based learning leads

to an augmentation in their overall satisfaction. The next solution (LSS), which incorporates the "presence" conditions *CQ, *CR, and *CU along with the "don't care" condition for OLE, yields a significant level of student satisfaction, as seen by a consistency value of 0.909 and coverage of 0.877.

The next findings indicate that the integration of video content in video-based learning and online learning experience that can lead to a configuration path characterized by "low" student satisfaction, hence providing support for Proposition 2 (see Figure 5). To provide further clarification, solutions of LSS result in a combination of conditions that are either "absence" or "do-not-care". Solution configuration for low satisfaction (LSS) exhibits the "absence" condition characterized by ~CU, ~CQ, ~OLE, and the "don't care" condition characterized by CR. It has a consistency value of 0.844 and insurance coverage of 0.387. This demonstrates that the lack of content understandability, quality, and online learning experience will adversely affect the overall students' satisfaction. This arrangement demonstrates that the lack of CU, CQ, and OLE is regarded as a factor contributing to diminished student satisfaction in engaging in online education.

Table 8. Truth Table Algorithm for High Outcome

Antecedents to Achieve High Students' Satisfaction						
CU	CR	CQ	OLE	Cases	High students' satisfaction outcome	Raw Consistency
Yes	Yes	Yes	Yes	88	Yes	0.972
No	No	No	Yes	1	Yes	0.969
No	No	Yes	Yes	1	Yes	0.968
No	Yes	Yes	No	1	Yes	0.892
Yes	Yes	Yes	No	35	Yes	0.886
No	Yes	No	No	2	Yes	0.861
No	No	No	No	1	Yes	0.859

Notes: CU: Content Understandability; CR: Content Reliability; CQ: Content Quality; OLE: Online Learning Experience

Table 9. Truth Table Algorithm for Low Outcome

Antecedents to Achieve Low Students' Satisfaction						
CU	CR	CQ	OLE	Cases	Low students' satisfaction outcome	Raw Consistency
No	No	Yes	No	2	Yes	0.869
No	No	No	No	1	Yes	0.863
No	No	Yes	Yes	1	Yes	0.818
No	Yes	Yes	No	1	No	0.749
Yes	Yes	Yes	No	1	No	0.716
No	Yes	No	No	35	No	0.484
No	No	No	No	88	No	0.250

Notes: CU: Content Understandability; CR: Content Reliability; CQ: Content Quality; OLE: Online Learning Experience

Table 10. The Configuration of High and Low Students' Satisfaction

Configuration	Solution to Achieve High Students' Satisfaction HSS	Solution to Avoid Low Students' Satisfaction LSS
Content Understandability	●	⊗
Content Reliability	●	
Content Quality	●	⊗
Online Learning Experience		⊗
Raw Coverage	0.876	0.367
Unique Coverage	0.679	0.073
Consistency	0.908	0.865
Overall Solution Coverage	0.893	0.387
Overall Solution Consistency	0.891	0.844

Notes: HSS: High Students' Satisfaction; LSS: Low Students' Satisfaction

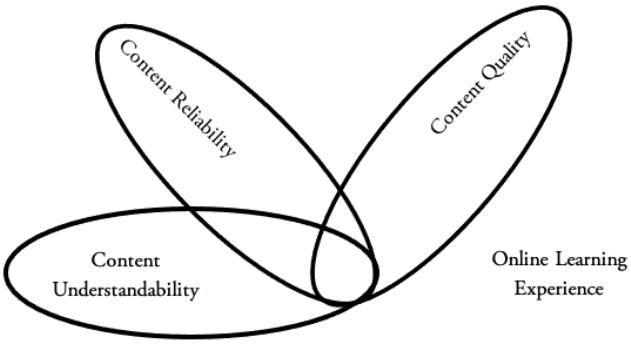

Figure 4. Configuration HSS that Contributes to Achieve High Students' Satisfaction

Note: Ellipse with solid line represents "presence" condition, meanwhile ellipse with no line represent "do-not-care" condition.

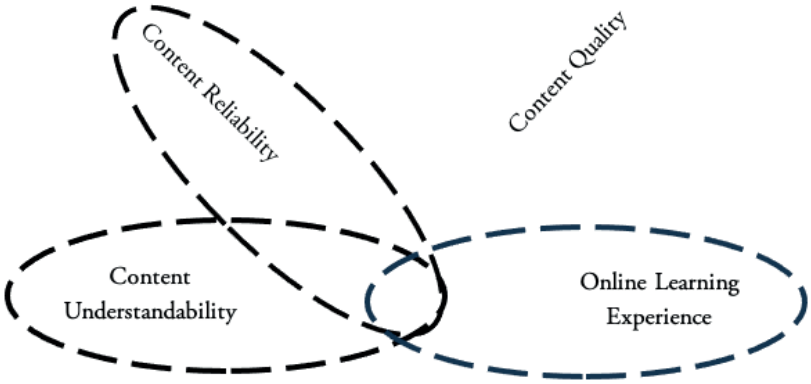

Figure 5. Configuration LSS that Contributes to Avoid High Students' Satisfaction

Note: Ellipse with doted-line represents "absence" condition, meanwhile ellipse with no line represent "do-not-care" condition.

DISCUSSIONS

This study offers valuable insights into the development of online learning experiences that use video content in video-based learning. It also examines the influence of comprehensibility, reliability, and quality of content on student satisfaction when engaging in online learning. The study use the structural equation modeling (SEM) technique to examine the causal association between constructs and to verify all submitted hypotheses. The results indicate that there is a significant impact of online learning on student satisfaction. Consistent with prior studies, Muzammil et al., (2021) asserted that online learning provides students with the autonomy to enhance their learning capabilities. Students are granted permission to use information and communication technology (ICT) into their educational endeavors, enabling them to engage in knowledge exploration and expand their perspectives (Inan Karagul et al., 2021). This is facilitated by the enhanced digital literacy among students, resulting in improved levels of active participation in the learning process. Hence, the utilization of online learning has the potential to enhance student satisfaction with the educational experience. In line with the results, Sever & Cati, (2021) finding confirmed that the enhancement of the digital literacy strenghtened satisfaction during the onlie learning. Therefore, the first hypothesis is corroborated. The concept of video-based learning involves the utilization of video information to enhance student learning methods (Sablic et al., 2021). The video content will facilitate students' comprehension of the learning material in situations where they perceive direct study with the teacher (Malakul & Park, 2023), whether in person or online, as insufficient. Conversely, the evaluation of video content is extensively examined within the realm of marketing (Romero-Rodriguez & Castillo-Abdul, 2023). Video content is employed as an instructional tool to elucidate complex concepts and topics, thereby providing students with tailored information that aligns with their specific learning needs (Dinmore, 2019).

This study aims to investigate the utilization of video content within an educational setting, specifically as a means to enhance the learning experience. Within the realm of video-based learning, it is imperative that the content is comprehensible, precise, and of superior quality in order to enhance students' comprehension (Malakul & Park, 2023). The results indicate that there is a positive and statistically significant relationship between content understandability, reliability, and quality in video-based learning and student satisfaction in the context of online learning. This assertion is grounded in the observation that the utilization of video content within video-based learning has the potential to foster students' comprehension of the learning process, hence exerting an impact on their attitudes. The concept of content understandability refers to the degree to which a video is able to facilitate comprehension for the user (Xu & Chen, 2006). Enhanced clarity in the video facilitates consumers' comprehension of the video's context. The concept of content reliability emphasizes the precision and dependability of the audiovisual environment (Xu & Chen, 2006). The higher the accuracy and relevance of the material to students' learning goals, the greater their interest in viewing the video content. Content quality pertains to the degree to which information aligns with user expectations and the level of excellence exhibited by the content (Xu & Chen, 2006). Moreover, when video content is comprehensible, dependable, and of superior quality, it will enhance student satisfaction in video-based learning. Thus, the findings provide support for hypotheses 2a, 2b, and 2c. This finding aligns with prior research, where prior research suggested that video content has the potential to enhance user engagement by providing easily comprehensible, high-quality, and trustworthy content, ultimately leading to user satisfaction (Al-Adwan et al., 2021; Sablic et al., 2021).

Based on prior scholarly investigations, video content has been identified as a valuable resource for users in acquiring information, particularly in the context of information and communication technology (Al-Adwan et al., 2021; Sablic et al., 2021). A significant number of pupils continue to struggle with comprehending the educational content when engaging in online learning (Ferri et al., 2020). This phenomenon may occur due to the diminished level of direct instructor involvement in the online learning process, resulting in a reduced amount of information received by pupils. Conversely, scholarly investigations also indicate that the efficacy of online media in facilitating learning remains suboptimal due to teachers' limited exploration of the advantages offered by information and communication technology (Al-Kumaim et al., 2021). Educators continue to employ traditional instructional approaches in the context of online media for the purpose of facilitating the learning process. This entails a transition from traditional classroom-based learning methods to virtual learning platforms, but using conventional instructional techniques. Consequently, students may encounter difficulties comprehending the subject matter. The results indicate that the relationship between content understandability in video-based learning and student satisfaction is influenced by the mediating factors of online learning experience. These findings elucidate that students will experience satisfaction when they engage in learning through online media that is designed with the comprehension of the video content. This suggests that the provision of easily comprehensible can enhance students' learning experience as well as satisfaction in the online learning process. Teachers are required to develop video-based courses that are seamlessly incorporated into online learning. These supporting video content should be educational and of high quality, facilitating students' comprehension of the learning material and ultimately fostering student satisfaction. Consistent with prior research, the provision of comprehensible information and high-quality films has been shown to enhance user satisfaction when accessing information and content inside posted videos (Malakul & Park, 2023). Consequently, the findings provide support for hypotheses 3a. This contrasts with the correlation between the content reliability, quality, online learning experience, and student satisfaction. The presence of unreliable information in video content can lead users to exhibit reluctance in further accessing the content (Zheng et al., 2017). Conversely, when the information or material presented in video content is accurate, genuine, and trustworthy, users are more likely to express satisfaction with the video content (Zheng et al., 2017). Nevertheless, the findings of this study indicate that the reliability and quality of content in video-based learning, which serves as an antecedent of online earning experience and student satisfaction, does not align with the emerging theoretical framework. Prior studies have posited that the reliability and quality of content videos may enhance user satisfaction (Kar, 2021). However, there is a dearth of empirical research investigating the impact of content video reliability, quality, and online learning experience within the educational domain, particularly in the context of enhancing students' satisfaction.

Based on configuration analysis in fs-QCA, complexity theory highlights the significance of video content (namely content understandability, reliability, and quality) and the online learning experience in achieving

high and low levels of student satisfaction. There exist two distinct approaches to attaining varying degrees of student satisfaction in the context of online learning. Furthermore, it is worth noting that every configuration exhibits a notable degree of consistency and comprehensiveness, suggesting that the resultant solutions include the essential prerequisites for attaining elevated levels of contentment while evading suboptimal levels of satisfaction. The configuration path in the HSS solution indicates that teachers can attain high levels of student satisfaction by effectively utilizing content understandability, reliability, and quality in video-based learning. Even though other models place emphasis on the "don't care" condition, it does not exert a substantial influence on the attainment of elevated levels of student satisfaction. Conversely, the primary determinant of diminished student satisfaction, as indicated by the LSS solution, is the lack of concern exhibited by teachers regarding the utilization of content understandability and content quality in video-based and online learning experience. These findings offer novel insights for research employing the fs-QCA approach, enabling universities to gain a new perspective on the implementation of online learning methods. In this scenario, it is crucial to engage in video content practice and foster online learning experiences for students.

CONCLUSION

Theoretical Implication

This study contributes to the current literature on online learning experiences, video content in video-based learning, and student satisfaction. This research offers valuable insights into effective ways for enhancing student satisfaction in online learning, specifically in the context of video-based learning, by presenting a framework model. The video-based learning conceptual model, which prioritizes the utilization of video information, is employed to enhance student satisfaction. The objective of this study is to investigate the impact of integrating online learning experiences with video content in video-based learning on student learning satisfaction. This study demonstrated a considerable improvement in student satisfaction as a result of the online learning experience. Therefore, it is possible to employ online learning methodologies in educational curriculum that incorporate information and communication technology in order to enhance the overall quality of learning. This study investigates three key aspects that contribute to the enhancement of student satisfaction in online learning through video-based learning. These factors include content understandability, content reliability, and content quality (Al-Adwan et al., 2021; Sablic et al., 2021). Student satisfaction in the online learning experience is enhanced by information and content that are comprehensible, reliable, and high quality (Sablic et al., 2021). There are three key characteristics that contribute to the adoption of video-based learning as a viable technique for enhancing the online learning experience. Furthermore, the inclusion of video content in video-based learning has been found to enhance student satisfaction, mostly due to the immersive nature of the online learning environment. Nevertheless, this study demonstrates that the combination of content quality and reliability, along with online learning experiences, is insufficient to foster student satisfaction in utilizing learning. To summarize, the findings of this study indicate that the understandability, reliability, and quality of content can enhance the online learning experience and student satisfaction to some extent. Moreover, the factor of content understandability is the sole determinant that may foster the online learning experience, hence enhancing student satisfaction. In order to enhance student satisfaction, researchers have the potential to incorporate factors such as content understandability, reliability, and quality in video-based learning (Al-Adwan et al., 2021; Sablic et al., 2021) within online learning experiences. Additionally, integrating content understandability in video-based learning with online learning satisfaction can contribute to the overall satisfaction of students.

In order to optimize student satisfaction, researchers can include video content into video-based learning by integrating online learning experiences into online learning practices, as indicated by the results of the fs-QCA configuration analysis. The establishment of causal conditions for high and low student satisfaction is contingent upon the level of theoretical complexity attained in this study. According to the results of this study, there exist two distinct solution configurations that can be employed to attain high levels of student satisfaction and prevent low levels of student satisfaction. Consequently, this research provides a theoretical foundation for future investigations focused on enhancing student satisfaction in the context of online learning.

University's Practice

This study also enhances university practice. As institutions develop techniques to enhance the online learning experience and student satisfaction, this assertion holds particular validity. With the increasing popularity of information and communication technology (ICT) in society, corporations, and governments, universities have the opportunity to enhance the effectiveness of online learning through the incorporation of video content in video-based learning. Examining the suitable determinants in video-based learning that influence the online learning experience has consequences for enhancing student satisfaction, hence yielding advantages for the university as a whole. For instance, this study was conducted in Indonesia and identified methods to enhance student satisfaction while evaluating the efficacy of the strategy's implementation. The findings of this study suggest that there is potential for the development of initiatives aimed at enhancing the online learning experience and increasing student satisfaction.

The present study revealed a substantial positive correlation between online learning experiences and video content in the context of video-based learning, and student satisfaction. In essence, the enhancement of the online learning experience is directly facilitated by the factors of content understandability, reliability, and quality (Al-Adwan et al., 2021; Sablic et al., 2021). Furthermore, the online learning experience plays a crucial role in enhancing student satisfaction. Creating content that is understandable, reliable, and high quality is crucial for fostering student satisfaction. Therefore, the findings of this study validate the notion that many parameters related to video content in video-based learning and online learning have a positive impact on enhancing student satisfaction.

In order to optimize student satisfaction, researchers can incorporate video content (including its understandability, reliability, and quality) in video-based learning and incorporating the online learning experience into the results of the fs-QCA configuration analysis. The theoretical complexity obtained in this research determines the configuration of causal conditions for high and low satisfaction. The research findings indicate the existence of two configurations that can be categorized as "high" and "low" levels in terms of student satisfaction. Consequently, these findings provide a theoretical basis for future studies focused on enhancing satisfaction in the context of online learning.

The findings of this analysis indicate that there is a substantial positive relationship between content understandability, reliability, quality, and student satisfaction. Put simply, incorporating video content into video-based learning is believed to enhance students' comprehension and hence boost their satisfaction. Therefore, the findings of this study validate that the elements related to video content, including content understandability, dependability, and quality, have a significant role in enhancing student satisfaction within the context of video-based learning. Universities can gain significant insights and perspectives by attaining high levels of student satisfaction, which in turn allows them to make better informed decisions and develop effective strategies. Furthermore, the findings of the fs-QCA expand the opportunities for institutions to enhance the caliber of their educational offerings. Each configuration yields distinct combinations that will lead to varying degrees of enjoyment, either high or low. This study demonstrates that the integration of the HSS configuration path, which yields a heightened level of satisfaction, and the LSS configuration path, which mitigates low student contentment, can be utilized to ascertain the extent of student satisfaction in the context of online learning in subsequent endeavors.

Limitation and Future Direction

Although this study has made substantial theoretical contributions and provided insights into students' learning practices, it is important to acknowledge its limitations. This study is constrained by the utilization of video content in video-based learning and its impact on the attainment of student satisfaction in online learning experiences. The research aims to investigate the influence of video-based learning and online learning experiences on students' satisfaction in order to enhance the overall online educational experience. The research primarily concentrates on examining the impact of video content, including its comprehensibility, dependability, and quality, on student satisfaction in the context of online learning. Overall, the primary conclusions indicate that students' satisfaction is substantially influenced by online learning experiences, as well as the quality and attributes of video content in video-based learning. This research also offers insights into the combinations of elements that contribute to both high and low levels of student satisfaction in online learning.

The limitations of this research encompass restricted applicability due to its exclusive concentration on Indonesian university students, a small sample size, dependence on self-reported data, and the possibility of bias in the sampling process. Despite its limitations and lack of surprise outcomes, this study has the potential to make a valuable contribution to the existing body of knowledge on video-based learning. According to Lorenzo & Moore (2002), the online learning experience encompasses five primary components: student satisfaction, learning effectiveness, faculty satisfaction, student access, and institutional cost effectiveness. Hence, it is anticipated that future investigations will ascertain the potential impact of online learning practices on enhancing learning effectiveness, faculty satisfaction, student access, and institutional cost effectiveness. Furthermore, this study relies on data collected from respondents in Indonesia, hence limiting its generalizability to other nations. This research exclusively focuses on the online learning experience in Indonesia, as it is being widely adopted in other countries. Hence, it is recommended that future studies expand the scope of the sample locations to encompass a broader range of countries, including both developed and developing nations. This study investigates the impact of video content implementation strategies on student satisfaction in video-based and online learning experiences. Nevertheless, online learning methodologies continue to possess extensive utility in attaining student satisfaction, even in the present era.

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THE MEASUREMENT OF UNIVERSITY STUDENT'S INTENTION TO USE THE REAL-TIME ONLINE LEARNING IN SRI LANKA

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ABSTRACT

The worldwide education system has experienced new-normal mode of teaching and learning with the prime support of the real-time online platforms especially during COVID-19 pandemic. However, the existing body of knowledge has not sufficiently dealt with it. To explore the student's intention to use the real-time online learning, Theory of Planned Behavior (TPB) has been adapted as the primary theoretical model. Followingly, the study attempted to decompose the TPB if the antecedents used three or more times in the literature. Consequently, the study recognized Perceived Usefulness, Perceived Ease of Use, Perceived Risk and Compatibility as the antecedents of Attitude, Perceived Self-Efficacy and Facilitating Conditions as the antecedents of Perceived Behavioral Control. This study used a structured online questionnaire to collect the responses from students of national universities in Sri Lanka. Consequently, 382 responses were collected. Data were analyzed using SmartPLS 4 and the proposed hypotheses were tested using PLS-SEM. All of the antecedents are also demonstrated to have a significant positive impact with the corresponding constructs of the TPB, in addition to the hypotheses put forth on attitude, perceived behavioral control, and subjective norm with the behavioral intention to use. The findings will be beneficial specifically to the policy makers to formulate key strategies to incorporate the real-time online learning in the education system, thus, the education will become more accessible and affordable.

Key Words: Real-time online learning, Theory of Planned Behavior (TPB), decomposed TPB, Sri Lanka.

INTRODUCTION

The rapid development of the internet and digital technologies has changed the way people access education. Internet-based online learning platforms have guaranteed the widespread availability of learning at anytime and anywhere, in contrast to traditional classroom-based learning (Gao, 2019). As a result, online learning is regarded as a convenient way to advance in one's academic career. As stated by Rosenberg (2001), online learning is timelier and more reliable, cheaper and provides accessibility to valuable services, chance to collaborate with worldwide community.

Online learning can be considered into two major categories namely synchronous and asynchronous learning. On the one hand, asynchronous learning is free from time and place related boundaries and is more self-paced and fewer instructor support (Bernard et al., 2004; Murphy et al., 2011; Xie et al., 2018). On the other hand synchronous learning attempts to enrich learning experience with real time communication, instant instructor support and natural language usage (Blau et al., 2017). But asynchronous learning challenges the richness and naturalness of the media. Media richness stands the extent to which the media provides instant feedback, allows verbal and non-verbal communication, customization and permits the natural language (Blau et al., 2017). Naturalness means extent to which media allows natural way of communication like face to face communication (Blau et al., 2017). Asynchronous learning is beneficial as it is more self-paced and enables participants to share knowledge or ideas without relying on the concurrent participation of other participants (Ogbonna et al., 2019). However, as per Hartnett (2015), in the asynchronous learning environment benefits to students will severely depend on the extent to which they have the facility to

organize studies at home, self-study skills with the motivation and follow the learning objectives. Also, the sufficient digital skills are needed to guarantee the effectiveness of the online leaning (Kim et al.,2019).

Synchronous online learning is advantageous in many aspects namely logistical, instructional and economical (Hannum, 2001). Logistical advantages demonstrate the flexible nature of the synchronous learning where teaching and learning process can be done irrespective of the locational boundary. In synchronous learning, the interaction is facilitated with the enriched multimedia resources, is called as instructional advantages. Moreover, the learning through synchronous online learning platforms eliminates cost related to travelling and time while allowing interaction of experts across the world (Hannum, 2001). In synchronous learning, academicians can incorporate various strategies to ensure that students are not distracted by asking frequent questions through text or audio Most interestingly, the recording can be made available in the asynchronous platforms for the future reference unlike traditional learning (Chen et al., 2005). Student's motivation and commitment for learning is therefore enhanced in synchronous online learning (Hrastinski, 2008). Thus, it is termed as "Live" or "Real-time" learning (Chen et al., 2005).

Asynchronous learning is a popular online learning system because it requires less network capacity and simpler technology (Hotcomm, 2003). Specifically, during COVID-19 pandemic, worldwide education system has mainly adopted a new learning model centered on real-time online learning platforms such as Zoom, Microsoft Teams to ensure continuous teaching and learning activities. Though the situation necessitated the focus on real-time online learning, most of the studies focused on asynchronous online learning platforms namely Moodle (Ilyas and Zaman, 2020; Ngafeeson and Gautam, 2021) MOOC (Yang & Su, 2017; Wang et al., 2020; Ishak, 2020) e-learning systems in general (Leejoeiwara, 2013; Hadadgar et al., 2016; Mo et al., 2021). It evidences that literature has not adequately dealt with real-time online learning (Chen et al., 2005).

Furthermore, studies on online learning have shown that students have mixed feelings about it. Some studies demonstrated that students encountered huge stress (Patricia, 2020), lower learning and difficulties in attentiveness (Besser et al., 2020), problems related to the lack of internet connectivity (Adnan & Anwar, 2020), loss of confidence in using technology especially the older adults (Nimrod, 2018), disengagement and lesser motivation (Adnan & Anwar, 2020). Moreover, online learning is considered unpleasant as it reduces motivation, self-efficacy and cognitive engagement. In the descriptive research design (Alawamleh et al., 2020) declared that online leaning has negative impact on student teacher communication and interaction.

Contrastingly, according to Kalpana and Vinayak (2018) and Warnecke & Pearson (2011), students perceived online leaning platform to be useful and beneficial in increasing performance thus, well-designed online learning tools need to be implemented by universities and institutes in order to add more value to the learning processes. This finding aligned with the results of Teo et al. (2011) where tutor quality, perceived usefulness, and facilitating conditions were used to measure e-learning acceptance and reveled young students with technological skills adopts e-learning more. Bali & Liu (2018) demonstrated that there are no statistically significant differences in learning approaches though face to face learning observed to be higher than online learning in terms of social presence, social interaction, and satisfaction. These controversial findings indicate that student's intention to use online learning needs to be empirically investigated with sound theoretical framework to understand student's intention to use real-time online learning.

Although many studies considered Theory of Planned Behavior (TPB) to predict intention to use online learning, it has not been adequately decomposed to understand the impact of each salient beliefs on it. Also, the contradictory findings from the previous studies indicated the need for the further empirical validation. Interestingly, non-availability of Sri Lankan studies with proper theoretical frame requires researcher to deepen the focus on real-time online learning in the Sri Lankan context.

Thus, this study focuses on following research objectives;

Research Objectives

1. To identify the frequently used antecedents with TPB to explore the intention to use the real-time online learning in Sri Lanka.
2. To demonstrate the impact of decomposed TPB (DTPB) on university student's intention to use the real-time online learning in Sri Lanka.

LITERATURE REVIEW

This section focuses on delivering a broad picture of main theoretical framework of the study and studies concerning online learning adoption.

Theory of Planned Behavior (TPB)

TPB is the extended version of the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980). Due to the shortcoming of TRA in dealing with behavior in which people have less volitional control, TPB has evolved (Ajzen, 1988). Ajzen (1991) emphasized that behavioral intention is influenced by three constructs namely attitude, subjective norm and perceived behavioral control. Interestingly, TPB identifies behavioral belief, normative belief and control belief which influences attitude, subjective norm and perceived behavioral control respectively.

TPB has been decomposed by Taylor & Todd (1995). Attitude has been identified with three external factors namely perceived usefulness, perceived ease of use and compatibility. Subjective norm has been decomposed with the peer influence and superior influence (Taylor & Todd, 1995). Perceived Behavioral Control were identified with three factors namely perceived self-efficacy, resource facilitating condition and technology facilitation condition (Taylor & Todd, 1995). Moreover, Taylor & Todd (1995) emphasized that TPB has a greater explanatory power compared to TPB if it is decomposed as it paves a way to understand the antecedent's behavior with the main constructs. DTPB provides a complete way and relevant to recognize factors affecting individual adoption to technology whereas TPB only deals with structure of beliefs and intention to use (Suoranta & Mattila, 2004).

Studies related to Online Learning

Online learning refers to any type of learning that relies on or is enhanced by electronic communication via the most recent information and communication technologies (Boumans, 2004). Online instruction has two modes of interaction: synchronous and asynchronous. Asynchronous learning allows for multiple interactions between a teacher and a student (Chen et al., 2005). Synchronous learning requires both parties to be present simultaneously for effective teaching and learning (Chen et al., 2005). Followingly, studies related to online learning is presented in the chronological order;

Ndubisi (2004) assessed the e-learning adoption using Blackboard using DTPB in Malaysia. The study decomposed the attitude with usefulness, ease of use and security, subjective norm with course leader's influence and perceived behavioral control with self-efficacy, computer experience, training, technology facilitation, and computer anxiety. Hierarchical multiple regression analysis has been used for data analysis. The model predicted 24% of the intention whereas 42% of attitude, 10% of subjective norm and 22% perceived behavioral control has been predicted. Followingly, Cheon et al. (2012) explored readiness to mobile learning in USA with 177 students. Structural Equation Modelling (SEM) was used for data analysis. Core constructs of TPB had identified with two antecedents with each where attitude with usefulness and ease of use, subjective norm with instructor and student readiness and behavioral control with self-efficacy and learner autonomy. The model predicted 87.2% of the variation.

Tagoe & Abakah (2014) investigated students' readiness for distance learning using mobile learning in Ghana with 400 students. TPB has been used as the main theoretical foundation. Consequently, attitude, subjective norm, and perceived behavioral control influenced intention. According to Santos & Okazaki (2013), only attitude and subjective norm influenced adoption to e-learning among Brazilian faculty member. The study used DTPB among 446 faculty members and data were analyzed using SEM. They decomposed attitude with usefulness, ease of use, relative advantage and compatibility, perceived behavioral control with facilitating resources and interactivity and subjective norm with peer influence.

Leejoeiwara (2013) analyzed adoption of online learning with the self-directed learning. DTPB were used and SEM were used to analyze the data from 542 students in Thailand. Moreover, attitude was decomposed with perceived relative advantage, simplicity, compatibility, trialability, observability, subjective norm with peer, family, superior, community and external influence and self-efficacy, resource and technology

facilitation were identified as antecedents of perceived behavioral control. All the identified association were significant except attitudinal antecedents namely relative advantage and trialability and external influence of subjective norm.

Ismail & Hosseini (2014) attempted to decompose the antecedents of the attitude of TPB to demonstrate the impact of students' knowledge sharing intention through e-learning systems in Malaysia. As per the findings, the attitude was significantly influenced by perceived usefulness and perceived ease of use, trust, and educational compatibility. This model explains 81% variation in attitude, and attitude explains nearly 60% of the variance of intention. Furthermore, Altawallbeh et al. (2015) studied adoption to e-learning with DTPB among academicians from the Jordanian universities. The study used 245 valid responses and analyzed using hierarchical multiple regression model. Attitude has decomposed with usefulness and ease of use, subjective norm has decomposed normative belief, perceived behavioral control has decomposed to internet self-efficacy, perceived accessibility and university support. The results revealed that only attitude and perceived behavioral control influenced behavioral intention.

Yang & Su (2017) studied student's behavior in MOOC with the integration of Technology Acceptance Model (TAM) and TPB in OpenCourseWare, Khan Academy, and Massive Open Online Courses (MOOCs). The study used PLS-SEM to analyze the data collected from 212 students. The results supported all the proposed hypotheses with the 68.7% prediction on intention. Moreover, Lai (2017) investigated use of Web 2.0 tools for learning in Taiwan using DTPB developed by Taylor & Todd (1995). It has predicted 73.1% of variation of intention.

Khasawneh (2017) studied attitude with the attitudinal beliefs such as usefulness, ease of use, trialability, observability and computer self-efficacy in Jordan. The model predicted 35.57% of behavioral intention. Furthermore, study conducted to investigate the adoption to WhatsApp learning of Mzuzu University in Malawi used quantitative questionnaire and semi-structured interviews. The collected data were analyzed descriptively using SPSS. The results revealed that WhatsApp is beneficial in learning as it provides instant data sharing, academic communication even after the class hours (Nyasulu & Chawinga, 2019). Also, study conducted by Gomez-Ramirez et al. (2019), investigated mobile learning with DTPB in Colombia. SPSS has been used for the data analysis. Further, usefulness and ease of use with attitude, instructor readiness, student's readiness with subjective norm and self-efficacy and learner autonomy with facilitating condition has identified as antecedents.

Nadlifatin et al. (2020) measured intention to use blended learning system with the integrated model of TAM and TPB in Taiwan and Indonesia. Only attitude was identified with two antecedents namely usefulness and ease of use. Notably, 41% of behavioral intention in Taiwan and 28% of Behavioral intention of Indonesia has been explained in the model. Also, Wang et al. (2020) analyzed leaner's behavior in MOOC in China. Online questionnaire from 638 students were collected and SEM were used for data analysis. Only attitude has decomposed with two factors namely usefulness and ease of use. The results revealed attitude, usefulness, subjective norm and behavioral control were significant and ease of use was not identified as a significant antecedent of attitude.

He et al. (2020) studied the importance of digital competence in student's digital informal learning in Belgium. Attitude has been decomposed to many antecedents, namely perceived ease of use, perceived usefulness, perceived enjoyment, educational compatibility and perceived behavioral control were further decomposed into facilitating conditions and digital competence. The study used SEM for data analysis and predicted 49% of the intention.

Kim et al. (2021) studied Korean student's acceptance towards online learning system. The study integrated TPB with TAM and analyzed the moderation effect of user innovativeness. Study used SEM for data analysis and results emphasized that only usefulness influenced attitude and also behavioral intention was influenced by attitude and subjective norm. Further, user innovativeness moderated the relationship between subjective norm and intention. In addition, Yao et al. (2022) conducted the study in Henan province China with 429 college students. The study integrated TAM with TPB with additional variable of Self-awareness relating to TAM and TPB constructs. Hypotheses were tested using SEM. The model explained 83.6% of the intention. Table 1 summaries the articles related to DTPB.

Perceived Risk and Online Learning

students naturally expose to numerous privacy-related risks when learning happens through real-time online platforms. It will have the chance of influencing the learner's motivation (Page & White, 2002). The perceived risk will negatively influence the adoption intention of current participants and future students who are yet to be enrolled in national universities (Liebermann & Stashevsky, 2002; Kim, 2021). Thus, the security risk is not only attributed to e-commerce participants but also, to students who engage in learning activities via real-time online learning platforms exposed to various security-related concerns (Kim, 2021).

Featherman & Pavlou (2003) have proposed different ways in which risk can be perceived in the context of e-service adoption. They identified six facets of risk, namely performance risk, financial risk, time risk, psychological risk, social risk, and privacy risk. Privacy and security risk are most prevalent in the current era (Kim, 2021). Thus, perceived risk needs to be recognized as a vital factor in online learning related studies. But perceived risk has been rarely considered. The study on South Korea in 2020 considered security concerns and privacy concerns as the external variable of Perceived Ease of Use. It indicates that the abovementioned concerns negatively influence Perceived Ease of use (Kim, 2021). Further, Perceived Usefulness and peer behavior significantly influence intention to use real-time online classes. However, Perceived Ease of Use does not. Moreover, this model contributes to nearly 68.8% variation in intention. Also, security concerns were further considered with the TRA's subjective norm to investigate intention to adopt Zoom application in Vietnam (Long & Khoi, 2020). The study revealed a significant negative influence on the subjective norm.

However, perceived risk has been considered as the antecedents of primary constructs of the TPB in other related fields, namely attitude (Lee, 2009; Liao et al., 2010; Sanayei & Bahmani, 2012; Xie et al., 2017) and perceived behavioral control (Xie et al., 2017). According to the researchers' knowledge, the studies that dealt with online learning are void with TPB. Nevertheless, there are pieces of evidence with TAM and TRA (Long & Khoi, 2020; Kim, 2021).

Table 1. Summary of the articles on the DTPB application

Attitude	Perceived usefulness	(Ndubisi, 2004) (Cheon et al., 2012) (Santos & Okazaki, 2013) (Tagoe & Abakah, 2014) (Ismail & Hosseini, 2014) (Altawallbeh et al., 2015) (Yang & Su, 2017) (Lai, 2017) (Khasawneh, 2017) (Gomez-Ramirez et al., 2019) (Nadlifatin et al., 2020) (He et al., 2020) (Wang et al., 2020) (Kim et al., 2021) (Yao et al., 2022)	15	17.65%
	Perceived ease of use	(Ndubisi, 2004) (Cheon et al., 2012) (Santos & Okazaki, 2013) (Tagoe & Abakah, 2014) (Ismail & Hosseini, 2014) (Altawallbeh et al., 2015) (Lai, 2017) (Khasawneh, 2017) (Yang & Su, 2017) ((Gomez-Ramirez et al., 2019) (He et al., 2020) (Nadlifatin et al., 2020) (Wang et al., 2020) (Kim et al., 2021) (Yao et al., 2022)	15	17.65%
	Perceived Compatibility	(Santos & Okazaki, 2013) (Leejoeiwara, 2013) (Ismail & Hosseini, 2014) (Lai, 2017) (He et al., 2020)	05	5.88%
	Trialability	(Leejoeiwara, 2013) (Khasawneh, 2017)	02	2.35%
	Observability	(Leejoeiwara, 2013) (Khasawneh, 2017)	02	2.35%
	Computer Self-efficacy	(Khasawneh, 2017)	01	1.18%
	Perceived enjoyment	(He et al., 2020)	01	1.18%
	Trust	(Ismail & Hosseini, 2014)	01	1.18%
	Self-awareness	(Yao et al., 2022)	01	1.18%
	Security	(Ndubisi, 2004)	01	1.18%
	Perceived Simplicity	(Leejoeiwara, 2013)	01	1.18%

Subjective Norm	Relative advantage	(Santos & Okazaki, 2013) (Leejoeiwara, 2013)	02	2.35%
	Peer influence	(Santos & Okazaki, 2013) (Leejoeiwara, 2013) (Lai, 2017)	03	3.53%
	Superior Influence	(Leejoeiwara, 2013) (Lai, 2017)	02	2.35%
	Course leader's influence	(Ndubisi, 2004)	01	1.18%
Perceived Behavioural Control	Family influence & External Influence & Community Influence	(Leejoeiwara, 2013)	01	1.18%
	Student readiness	(Cheon et al., 2012) (Tagoe & Abakah, 2014) (Gomez-Ramirez et al., 2019)	03	3.53%
	Instructor Readiness	(Cheon et al., 2012) (Gomez-Ramirez et al., 2019)	02	2.35%
	Self-awareness	(Yao et al., 2022)	01	1.18%
	Self-Efficacy	(Ndubisi, 2004) (Cheon et al., 2012) (Leejoeiwara, 2013) (Tagoe & Abakah, 2014) (Altawallbeh et al., 2015) (Lai, 2017) (Gomez-Ramirez et al., 2019)	07	8.24%
	Facilitating Condition	(Ndubisi, 2004) (Santos & Okazaki, 2013), (Leejoeiwara, 2013) (Lai, 2017) (He et al., 2020)	05	5.88%
	Computer experience & Training & Computer anxiety	(Ndubisi, 2004)	01	1.18%
	Perceived accessibility & University support	(Altawallbeh et al., 2015)	01	1.18%
	Learning autonomy	(Cheon et al., 2012) (Tagoe & Abakah, 2014) (Gomez-Ramirez et al., 2019)	03	3.53%
	Self-awareness	(Yao et al., 2022)	01	1.18%
	Interactivity	(Santos & Okazaki, 2013)	01	1.18%
	Digital Competence	(He et al., 2020)	01	1.18%

In summary, due to the scarce of studies deals with decomposed TPB in real-time online learning setting, this research intends understand adoption to real-time online learning by decomposing TPB. Researcher extensively reviewed online learning related articles for the period of 2002 to 2022. Literature review identified several gaps in the online learning context.

Firstly, most of the researchers studied online learning using TPB. But, there is a lack in the decomposition of the theory to comprehend the effect of each belief on the primary constructs of TPB (Leejoeiwara, 2013; Lai, 2017; Gomez-Ramirez et al., 2019; Cheon et al., 2012; Tagoe & Abakah, 2014; He et al., 2020). None of the studies has been conducted in the Sri Lankan context.

Secondly, existing studies related with TPB and DTPB has accounted for controversial findings. In summation, concerning TPB, many studies revealed that attitude, subjective norms, and perceived behavioral control exerted significant influence on adoption intention (Al-Harbi, 2011; Gomez-Ramirez et al., 2019; Yang & Su, 2017; Ilyas & Zaman, 2020, Cheon et al., 2012; Leejoeiwara, 2013;Lai, 2017; Wang et al., 2020). Some researchers demonstrated that neither perceived behavioral control (Teo & Lee, 2010; Kim et al., 2021; Santos & Okazaki, 2013) nor subjective norm (Hadadgar et al., 2016; He et al., 2020; Tagoe & Abakah, 2014) plays a significant role in determining intention to use. In many studies, the attitude was the most influencing construct on intention decision. However, in contrast, studies have shown perceived behavioral control as the first significant determinant of adoption intention (Clutterbuck et al., 2015; Cheon et al., 2012; Tagoe & Abakah, 2014). Also, the attitude has not significantly influenced behavioral intention in some studies (Masruf & Teng, 2016). These controversies indicate that the existing knowledge cannot be applied directly to predict the acceptance of technology in different context. Thus, there is a need for the new study to understand Sri Lankan students' intention to adopt online learning.

Thirdly, many studies explored online learning with asynchronous learning platforms such as Moodle (Ilyas & Zaman, 2020; Ngafeeson & Gautam, 2021) MOOC (Wang et al., 2020; Ishak, 2020; Yang & Su, 2017) e-learning systems in general (Mo et al., 2021; Hadadgar et al., 2016; Leejoeiwara, 2013). However, very few have dealt with the real-time online learning platform. Among them, some evidence with TAM (Alfadda & Mahdi, 2021; Purwanto & Tannady, 2020; Bhatt & Shiva, 2020; Faisal et al., 2021; Kim, 2021) and TRA

(Long & Khoi, 2020). It is also noteworthy that none of those above studies were attempted to assess the adoption of real-time online learning using TPB in international and Sri Lankan context.

In addition, TPB has proved its successful application by combining perceived risk in various phenomena such as Internet banking (Sanayei & Bahmani, 2012; Obaid & Aldammagh, 2021; Kim et al., 2016) online shopping (Kim, 2020; Ha, 2020) e-government (Xie et al., 2017) and e-health (Gu et al., 2019). Even though many online related researches discussed students' perception of online learning using many theoretical perspectives, very few of them had recognized perceived risk as a vital factor.

Finally, few descriptive studies have been investigated students' perception of online learning in Sri Lankan context (Vidanagama, 2016; Jayakananthan & Jeyaraj, 2019; Samsudeen & Mohamed, 2019; Pirapuraj et al., 2019; Selvaras, 2020; Rameez et al., 2020; Nafrees et al., 2020; ; Nawaz & Mohamed, 2020; Abdullah et al., 2021; Nayanajith & Damunupola, 2021). It has also been noticed that the studies available in the local context lack the application of PLS-SEM approaches though it is being extensively applied to study the adoption of online learning. Conclusively, this study is conducted to address above-specified lapses in the existing knowledge.

Definition of Variable

This section defines the concepts of the study.

- *Attitude:* Attitude refers to an individual's evaluative judgments about the consequences of using real-time online learning (Ajzen, 1991).
- *Perceived Usefulness:* Perceived Usefulness stands to the extent to which students perceive that real-time online learning is beneficial to enhancing performance (Davis, 1989).
- *Perceived Ease of Use:* Perceived Ease of Use refers to the degree to which students feel that real-time online learning is easier to use and free from additional effort (Davis, 1989).
- *Compatibility:* Compatibility represents the extent to which students perceive that real-time online learning is well-suited according to their needs and experiences (Rogers, 2003).
- *Perceived Security Risk:* It refers to the students' negative perception about the uncertainty involved concerning the deprival of personally identifiable information in real-time online learning (Featherman & Pavlou, 2003).
- *Subjective Norm:* Subjective norm explains students' belief about the degree to which referent others will influence their learning through real-time online learning (Ajzen, 1991).
- *Perceived Behavioral Control:* It refers to students' perception of the ease or difficulty of adopting real-time online learning (Ajzen, 1991).
- *Perceived Self-Efficacy:* It refers to the extent to which the learners have confident about his/her capability to use real-time online learning (Bandura,2005).
- *Facilitating Conditions:* Facilitating Conditions means persons' perception of the degree to which organizational and technological resources are available to facilitate real-time online learning usage (Venkatesh et al., 2003).

METHOD

This study attempted to postulate hypotheses and validate them through empirical investigation. Thus, the research follows deductive approach with positivist perspective. Additionally, a self-administered questionnaire survey has been employed as the research strategy. Also, the research choice of this study is the mono-method as it uses single quantitative data collection technique and data analysis using statistical techniques.

Conceptualization & Hypotheses Development

Attitude

Among the previous researches, it has been empirically proved that attitude exerts positive influence on behavioral intention to use (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe & Abakah, 2014; Ismail & Hosseini, 2014; Clutterbuck et al., 2015; Hadadgar et al., 2016; Lai, 2017; Mangir et al., 2017; Yang & Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Nadlifatin et al., 2020; Ilyas & Zaman, 2020; Gao, 2020; He et al., 2020; Purwanto & Tannady, 2020; Bhatt & Shiva, 2020; Long & Khoi, 2020; Alfadda & Mahdi, 2021).

Hence, based on the above premise, the following hypothesis is proposed;

H1: Attitude will positively influence the Behavioral Intention to Use real-time online learning.

Perceived Usefulness

Many past studies have justified that the positive impact of perceived usefulness exists with attitude (Cheon et al., 2012; Tagoe & Abakah, 2014; Ismail & Hosseini, 2014; Lai, 2017; Yang & Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Nadlifatin et al., 2020; Wang et al., 2020; Gao, 2020; He et al., 2020; Purwanto & Tannady, 2020; Bhatt & Shiva, 2020; Alfadda & Mahdi, 2021; Kim et al., 2021)

Hence, based on the above premise, the following hypothesis is proposed;

H2: Perceived Usefulness positively affects Attitude to adopt real-time online learning.

Perceived Ease of Use

Many researchers reported a positive effect of Perceived Ease of Use on attitude (Cheon et al., 2012; Tagoe & Abakah, 2014; Ismail & Hosseini, 2014; Lai, 2017; Yang & Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019). With TAM also reported to have the positive impact (Purwanto & Tannady, 2020; Bhatt & Shiva, 2020 Alfadda & Mahdi, 2021).

Hence, based on the above premise, the following hypothesis is proposed;

H3: Perceived Ease of Use positively affects Attitude to adopt real-time online learning.

Compatibility

Many researchers empirically proved that compatibility has a positive effect on attitude (Santos & Okazaki, 2013; Ismail & Hosseini, 2014; Lai, 2017; He et al., 2020).

Hence, based on the above premise, the following hypothesis is proposed;

H4: Compatibility will positively affect Attitude to adopt real-time online learning.

Perceived Security Risk

Previous studies have proven the negative impact of perceived risk on attitude (Lee, 2009; Sanayei & Bahmani, 2012; Liao et al., 2010; Xie et al., 2017).

Hence, based on the above premise, the following hypothesis is proposed;

H5: Perceived Risk will negatively affect Attitude to adopt real-time online learning.

Subjective Norm

Positive effect subjective norm on behavioral intention to use has been empirically proved by numerous scholars (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe & Abakah, 2014; Clutterbuck et al., 2015; Masruf & Teng, 2016; Lai, 2017; Mangir et al., 2017; Yang & Su, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Nadlifatin et al., 2020; Ilyas & Zaman, 2020; Wang et al., 2020; Kim et al., 2021).

Hence, based on the above premise, the following hypothesis is proposed;

H6: Subjective Norm will positively influence the Behavioral Intention to Use real-time online learning.

Perceived Behavioral Control

Positive impact of perceived behavioral control on intention to use the online education platforms has been proved by many researchers (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe and Abakah, 2014; Clutterbuck et al., 2015; Masruf & Teng, 2016; Hadadgar et al., 2016; Lai, 2017; Mangir et al., 2017; Yang & Su, 2017; Gomez-Ramirez et al., 2019; Nadlifatin et al., , 2020; Ilyas & Zaman, 2020; Wang et al., 2020; Gao, 2020; He et al., 2020; Ngafeeson & Gautam, 2021).

Hence, based on the above premise, the following hypothesis is proposed;

H7: Perceived Behavioral Control will positively influence the Behavioral Intention to Use real-time online learning.

Perceived Self-Efficacy

Previous research shows a positive impact on perceived behavioral control (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe & Abakah, 2014; Lai, 2017; Gomez-Ramirez, 2019).

Hence, based on the above premise, the following hypothesis is proposed;

H8: Perceived Self-Efficacy positively affects Perceived Behavioral Control to adopt real-time online learning.

Facilitating Conditions

Positive impact of facilitating conditions and perceived behavioral control has been proved by some researchers (Leejoeiwara, 2013; Lai, 2017;).

Hence, based on the above premise, the following hypothesis is proposed;

H9: Facilitating conditions will positively affect Perceived Behavioral Control to adopt real-time online learning.

Figure 1 portrays the conceptual model of the study.

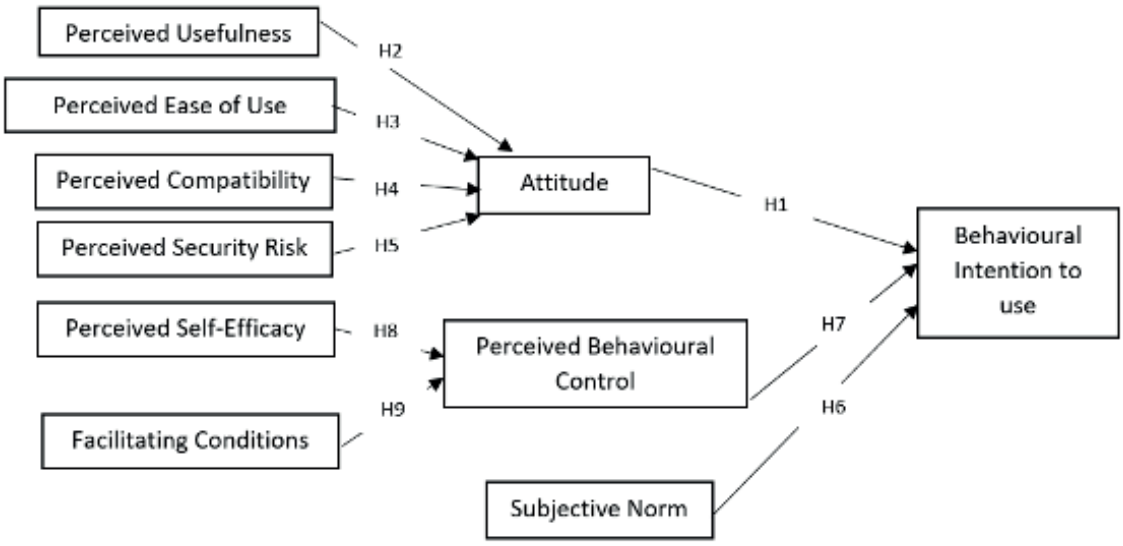

Figure 1. Conceptual framework of the study

Participants

The study's target population is undergraduates enrolled in the state universities of Sri Lanka. Altogether fifteen universities are located across nine provinces in Sri Lanka (UGC Sri Lanka, 2020). The Table 2 depicts the universities and their associated provinces of them. Based on the convenience sampling technique, study data were collected since this is an easy technique to access the widespread sample (Sekaran, 2003). The responses were collected in 2023. From 400 sample units, during the inspection process, 18 were removed due to the incompleteness and 382 valid responses were considered in the study.

Table 2. Universities with associated provinces

University	Province
Rajarata University	North Central
Wayamba University	North Western
Sabaragamuwa University	Sabaragamuwa
University of Peradeniya	Central
Uva Wellassa University	Uva
University of Ruhuna	Southern
University of Sri Jayewardenepura	Western
University of Colombo	
University of Kelaniya	
University of Moratuwa	
Open University	
University of the Visual and Performing Arts	
University of Jaffna	Northern
Eastern University	Eastern
South Eastern University	

Data Collection and Analysis

According to Sekaran (2003), the questionnaire is a very efficient data collection method in which well-organized questions will be asked from respondents where they need to provide the answer. In this study, the questionnaire was distributed electronically using e-mails, WhatsApp groups, and Facebook messenger. Questionnaire has been adapted from literature and modified according to the needs of the study. Table 3 and Table 4 respectively represents the literature sources of the items adapted and items used for this study. The Five-point Likert scale were used to assign weights to measure the model variables and "5" for strongly agree, "4" for agree, "3" for neither agree nor disagree, "2" for disagree, and "1" for strongly disagree (Allen & Seaman, 2007). Because, Likert scale is recommended for rating questions (Saunders et al., 2007).

The partial least square structural equation modeling has been used to test the hypothesis using SmartPLS 4 (Ringle et al., 2005). Assessment of measurement model indicates the relationship between items and the latent variable being studied. It can be evaluated using reliability and validity tests, namely convergent and discriminant validity. The structural model assessment needs to be tested for multicollinearity using VIF and Tolerance. Furthermore, the coefficient of determination will be used to measure the dependent variable's variance caused by all concerned predictors. PLS-SEM path co-efficient is used to test the hypothesis with associated t-values and p-values.

Table 3. Variables with literature sources

Variables	Items	Literature sources
Attitude	04	(Taylor & Todd, 1995)
Perceived Usefulness	07	(DeLone & Mclean, 2003; Chiu & Wang, 2008; Ho & Dzeng, 2010; Hassanzadeh et al., 2012)
Perceived Ease of Use	05	(DeLone & Mclean, 2003; Wang & Liao, 2008)
Perceived Compatibility	03	(Taylor & Todd, 1995)
Perceived Security Risk	04	(Featherman & Pavlou, 2003; Gefen, 2000; Kim, 2020)
Perceived Behavioural Control	03	(Wu & Chen, 2005)
Perceived Self-Efficacy	03	(Taylor & Todd, 1995)
Facilitating Conditions	03	(Venkatesh et al., 2012)
Subjective Norm	03	(Wu & Chen, 2005)
Behavioural intention to use	03	(Cheng et al., 2006)

Table 4. Variables with items

Attitude (ATT)	ATT_01	Using real-time online learning is a good idea
	ATT_02	Using real-time online learning is a wise idea
	ATT_03	I like the idea of using real-time online learning
	ATT_04	Using real-time online learning would be pleasant
Perceived Usefulness(PU)	PU_01	I think that real-time online learning helps to save time
	PU_02	I think that real-time online learning helps to save cost
	PU_03	I think that real-time online learning helps me to be self-reliable
	PU_04	I think that real-time online learning helps to improve my knowledge
	PU_05	I think that real-time online learning helps to improve my performance
	PU_06	I think that real-time online learning is effective
	PU_07	I think that real-time online learning is efficient
Perceived Ease of Use(PEOU)	PEOU_01	I think that real-time online learning is easy to use
	PEOU_02	I think that real-time online learning is easy to learn
	PEOU_03	I think that real-time online learning is easy to access
	PEOU_04	I think that real-time online learning is easy to understand
	PEOU_05	I think that real-time online learning is convenient
Perceived Compatibility(COM)	COM_01	Using real-time online learning will fit well with the way I learn.
	COM_02	Using real-time online learning will fit into my learning style.
	COM_03	The setup of real-time online learning will be compatible with the way I learn.
Perceived Security Risk(PSR)	PSR_01	I do not feel secure about online learning resources or tools used in real-time online learning.

	PSR_02	I am concerned that online learning resources or tools providers will not implement appropriate security measures for user protection.
	PSR_03	I am concerned that hacking happened in real-time online learning will lead to disclosing my personal information.
	PSR_04	I am concerned that hackers will disrupt my online class due to the poor security of online learning resources or tools.
Perceived Behavioral Control(PBC)	PBC_01	Using real-time online learning is entirely within my control
	PBC_02	I have the resources, knowledge, and ability to make use of real-time online learning
	PBC_03	I think that I would be able to use real-time online learning well for my learning activities
Perceived Self-Efficacy(PSE)	PSE_01	I would feel comfortable using real-time online learning system on my own.
	PSE_02	If I want to, I can use real-time online learning system on my own easily.
	PSE_03	I would be able to use real-time online learning system even if there is no one around to show me how to use it.
Facilitating Conditions(FC)	FC_01	I have the resources necessary to use real-time online learning.
	FC_02	I have the knowledge necessary to use real-time online learning.
	FC_03	Real-time online learning is compatible with other technologies I use.
Subjective Norm (SN)	SN_01	People who influence my behavior would think that I should use real-time online learning
	SN_02	People who are important to me would think that I should use real-time online learning
	SN_03	People whose opinions are valued to me would think that I should use real-time online learning
Behavioral Intention to Use(BITU)	BITU_01	I would use real-time online learning for my learning needs.
	BITU_02	Using real-time online learning for learning is something I would do.
	BITU_03	I would see myself using real-time online learning for doing my learning activities.

FINDINGS

Assessment of the Measurement Model

Measurement model can be evaluated using reliability and validity tests namely convergent and discriminant validity (Chin, 1998). Convergent validity measures the related items of a construct are loaded significantly with each other whereas discriminant validity assesses two unrelated constructs are not significantly loaded with each other (Sekaran, 2003).

Reliability of the Constructs and Indicators

Reliability test is used to measure the internal consistency of constructs and indicators. In this study, cronbach's alpha and composite reliability have been used to measure the construct reliability (Dakduk et al., 2019) and to assess the indicator reliability outer loading has been used (Hulland, 1999; Wong, 2013).

Generally, Cronbach's Alpha value lies less than 0.60 is considered low, 0.70 is considered acceptable, and greater than 0.80 is considered excellent internal consistency (Sekaran, 2003). Due to the conservative measurement of the Cronbach's Alpha, Dakduk et al. (2019) suggested composite reliability is referred to as McDonald's coefficient, to measure the construct reliability. It is needed to be loaded to 0.70 or above in order to ensure the composite reliability (Bagozzi and Yi, 1988; Dakduk et al., 2019). Also, the outer loadings of the indicator are needed to be loaded with 0.70 or above is preferred, but 0.4 or greater is adequate (Hulland, 1999; Wong, 2013). As per the Table 5, Cronbach's alpha, composite reliability is above the acceptable value of 0.70 and factor loadings are above 0.50. Thus, it can be concluded that the internal consistency of constructs and indicators is well-established.

Table 5. Reliability of the constructs and indicators

Construct	Items	Item loadings	Cronbachalpha	Composite reliability
ATT	ATT1	0.735	0.825	0.843
	ATT2	0.574		
	ATT3	0.833		
	ATT4	0.805		
PU	PU1	0.683	0.896	0.904
	PU2	0.584		
	PU3	0.799		
	PU4	0.759		
	PU5	0.711		
	PU6	0.873		
	PU7	0.783		
PEOU	PEOU1	0.664	0.893	0.900
	PEOU2	0.820		
	PEOU3	0.762		
	PEOU4	0.805		
	PEOU5	0.895		
COM	COM1	0.918	0.923	0.923
	COM2	0.871		
	COM3	0.893		
PSR	PSR1	0.541	0.873	0.896
	PSR2	0.837		
	PSR3	0.798		
	PSR4	0.947		
PBC	PBC1	0.749	0.849	0.854
	PBC2	0.805		
	PBC3	0.868		
FC	FC1	0.832	0.880	0.885
	FC2	0.817		
	FC3	0.858		
	FC4	0.709		
PSE	PS1	0.853	0.874	0.875
	PS2	0.839		
	PS3	0.816		
SN	SN1	0.861	0.896	0.896
	SN2	0.869		
	SN3	0.854		
BITU	BITU1	0.892	0.916	0.920
	BITU2	0.819		
	BITU3	0.943		

Validity of the Constructs and Indicators

Convergent Validity

Convergent validity refers to the extent to which the items to measures the same constructs is related to one and another. To measure it, Average Variance Extracted (AVE) is used. The AVE must be assumed more than 0.50 to establish convergent validity (AVE >0.50) (Hair et al., 2010). Table 6 shows the AVE of the constructs are above 0.50. Thus, the convergent validity is established.

Table 6. Convergent validity

Construct	AVE
ATT	0.553
PU	0.557
PEOU	0.629
COM	0.799
PSR	0.632
PBC	0.654
FC	0.649
PSE	0.699
SN	0.742
BITU	0.785

Discriminant Validity

Discriminant value tests the degree to which the variables in the model are not related with the other variables in the model (Chin, 1998). In this study cross loadings, Fornell-Larcker Scale, Heterotrait-Monotrait (HTMT) ratios has been used. To assume discriminate validity, squared root of a variable's AVE need to be greater than the that of the other constructs and must be more than 0.50 (Fornell & Larcker, 1981). Cross loadings of the items in a construct are needed to be significantly loaded in the same constructs than other constructs (Cheng & Chen, 2015). Further, HTMT ratio has been used to measure the discriminate validity since it is based on the multitrait-multimethod matrix (Henseler et al., 2015). If the HTMT ratio is lower than the 0.85, the discriminate validity will be assumed (Kline, 2011). As per the cross loadings, each item in the construct are loaded in the same construct than the other. Further, Table 7 evidences the existence of the discriminant validity using Fornell-Larcker Scale. Further, Table 8 evidences the existence of the discriminant validity using HTMT Ratio. According to the statistical evidences, the discriminant validity is established.

Table 7. Assessment of discriminant validity using Fornell-Larcker Scale

	ATT	FC	BITU	PBC	COM	PEOU	PSR	PSE	PU	SN
ATT	0.744									
FC	0.619	0.806								
BITU	0.583	0.634	0.886							
PBC	0.66	0.813	0.620	0.809						
COM	0.704	0.609	0.654	0.729	0.894					
PEOU	0.741	0.722	0.654	0.756	0.727	0.793				
PSR	0.264	0.347	0.287	0.424	0.333	0.299	0.795			
PSE	0.638	0.817	0.644	0.833	0.63	0.683	0.343	0.836		
PU	0.797	0.66	0.628	0.733	0.784	0.832	0.357	0.664	0.747	
SN	0.577	0.597	0.611	0.562	0.647	0.581	0.414	0.55	0.619	0.861

Table 8. Assessment of discriminant validity using HTMT Ratio

	ATT	FC	BITU	PBC	COM	PEOU	PSR	PSE	PU	SN
ATT										
FC	0.621									
BITU	0.585	0.632								
PBC	0.663	0.814	0.618							
COM	0.703	0.608	0.651	0.729						
PEOU	0.744	0.727	0.653	0.755	0.723					
PSR	0.263	0.345	0.291	0.429	0.327	0.302				
PSE	0.638	0.818	0.644	0.834	0.629	0.684	0.337			
PU	0.799	0.663	0.628	0.738	0.784	0.834	0.362	0.666		
SN	0.58	0.597	0.611	0.566	0.646	0.582	0.414	0.55	0.617	

Assessment of the Structural Model

Multicollinearity (VIF)

Multicollinearity assesses the extent to which two or more independent variables are corelated with each other (Hair et al., 2010). Multicollinearity is detected if the variance inflation factor (VIF) is more than 5. As portrayed in the Table 9 VIF values are below 5, indicates the absence of multicollinearity (Hair et al., 2011; Ringle et al., 2015).

Table 9. Assessment of Multicollinearity using VIF

Dependent variable	Independent variable	VIF
ATT	PU	4.255
	PEOU	3.411
	COM	2.752
	PSR	1.156
PBC	PS	3.005
	FC	3.005
BITU	ATT	1.993
	PBC	1.942
	SN	1.643

Coefficient of Determination (R^2)

Coefficient of determination demonstrates the variation on the dependent variable caused by all of its independent variables (Dreheeb et al., 2016). If the R^2 value is less than 0.67, in between 0.19 to 0.33, in between 0.33 to 0.67 and more than 0.67 it will be respectively assumed extremely weak, weak, moderate and significant variance in the dependent variable Chin (1998). Table 10 summaries the R^2 value and result of the proposed model.

Table 10. R^2 of the independent variables

Construct	R^2	Adjusted R^2	Results
ATT	0.666	0.663	Moderate
PBC	0.747	0.746	Significant
BITU	0.503	0.499	Moderate

Effect Size (f^2)

The effect size measures the impact of the eliminated constructs on the independent variable (Sarstedt et al., 2017). f^2 values 0.02,0.15 and 0.35 represent small, medium and large effects respectively. As per the Table 11, perceived usefulness, perceived ease of use, compatibility and perceived security risk have respectively identified with 0.177 (medium effect), 0.04 (small effect), 0.031(small effect), 0.003(small effect) effects on attitude. Perceived self-efficacy and facilitating condition has the medium effect on the perceived behavioral control. Small effects are identified on behavioral intention to use by all of its exogenous variables namely attitude, perceived behavioral control and subjective norm.

Table 11. Assessment of Effect Size(f2)

Dependent variable	Independent variable	f^2	Results
ATT	PU	0.177	Medium
	PEOU	0.04	Small
	COM	0.031	Small
	PSR	0.003	Small
PBC	PS	0.338	Medium
	FC	0.210	Medium
BITU	ATT	0.036	Small
	PBC	0.101	Small
	SN	0.131	Small

Predictive Relevance (Q2)

Wong (2013) mentioned that the Q2 value of 0.02, 0.15, and 0.35 respectively demonstrates that predictor has a small, medium, and large predictive relevance on the dependent variable. As demonstrated in the Table 12, attitude, perceived behavioral control and behavioral intention to use has the large predictive relevance.

Table 12. Assessment of predictive relevance (Q2)

Dependent variable	Q^2	Results
ATT	0.517	Large
PBC	0.582	Large
BITU	0.454	Large

Hypotheses Testing

Table 13 and Figure 2 portray the brief of the results of the model. In summary, all the proposed hypotheses are supported. Perceived usefulness use (β= 0.501, p-value <0.05), perceived ease of use (β= 0.212, p-value <0.05), compatibility (β= 0.167, p-value <0.05), and perceived security risk (β= -0.034, p-value <0.05), has the significant impact on the behavioral intention to use, lead to the acceptance of the H2, H3, H4, H5. Hypotheses H8 and H9 are supported since the perceived self-efficacy (β= 0.507, p-value <0.05), and facilitating condition (β= 0.400, p-value <0.05), has the significant impact on the behavioral intention to use.

Table 13. Results of the hypothesis testing

Hypothesis	Relationship	path	p-value	Decision
H1	Attitude → Behavioural Intention to use	0.188	0.047	Supported
H2	Perceived Usefulness → Attitude	0.501	0.000	Supported
H3	Perceived Ease of Use → Attitude	0.212	0.000	Supported
H4	Compatibility → Attitude	0.167	0.000	Supported
H5	Perceived Security Risk → Attitude	-0.034	0.000	Supported
H6	Subjective Norm → Behavioural Intention to use	0.327	0.000	Supported
H7	Perceived Behavioural Control → Behavioural Intention to use	0.312	0.001	Supported
H8	Perceived Self-Efficacy → Perceived Behavioural Control	0.507	0.000	Supported
H9	Facilitating Conditions → Perceived Behavioural Contro	0.400	0.002	Supported

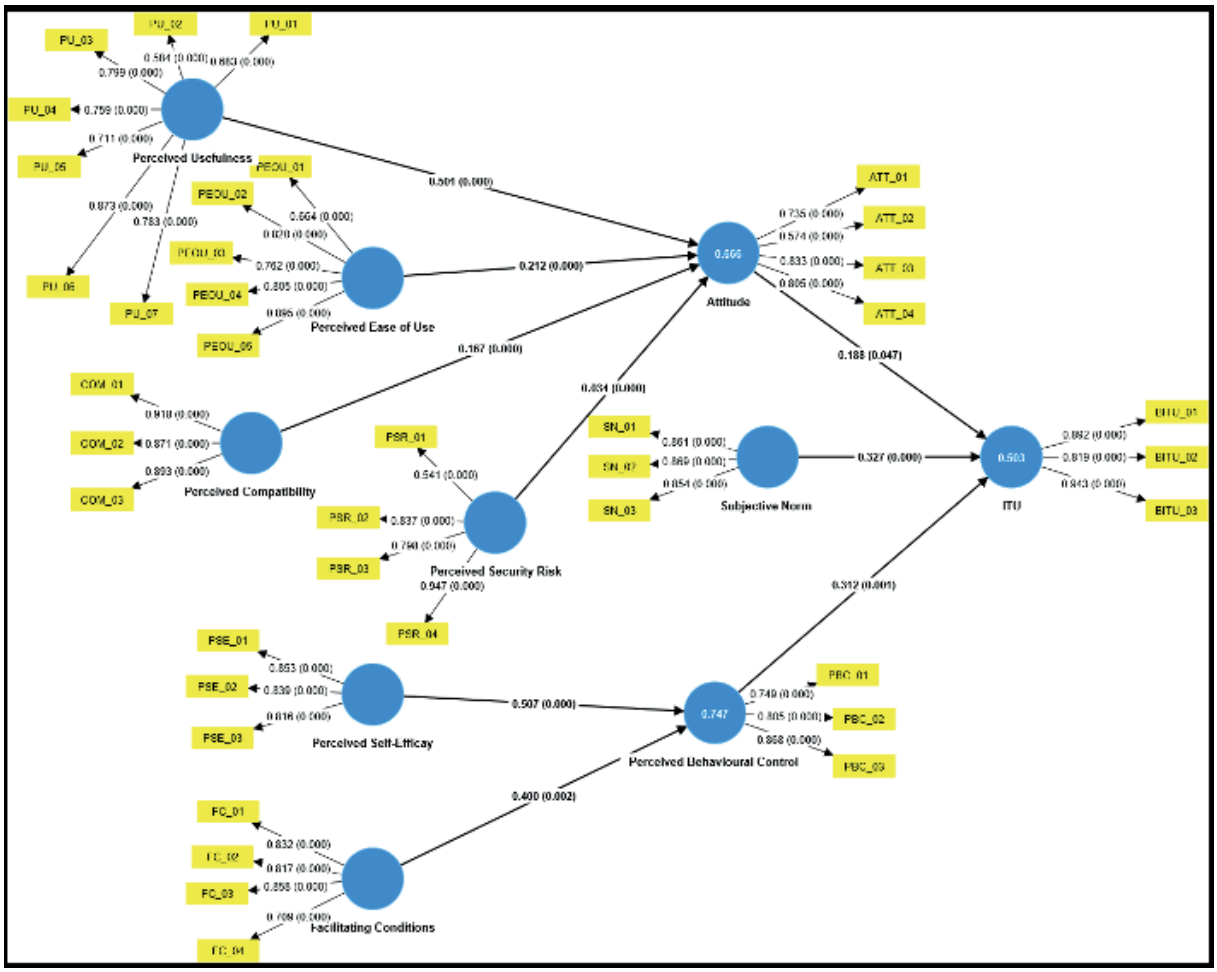

Figure 2. PLS-SEM path diagram

DISCUSSION

Research Question 01

Twenty years of published articles from 2002 to 2022 in the context of online learning has been reviewed to identify frequently considered antecedents of TPB and contradictions of the findings. The researcher attempted to find and include if an antecedent was considered more than three times in a relevant study. As per the literature, Perceived Usefulness, Perceived Ease of Use, Perceived Risk, Compatibility as the antecedents of Attitude, followingly, Perceived Self-Efficacy, Facilitating Conditions as the antecedents of Perceived Behavioral Control has been recognized as antecedents. In a nutshell, TPB has been extended by applying widely recognized antecedents to assess the adoption of real-time online learning in the Sri Lankan context.

Research Question 02

As portrayed in the Table 9, 66.6% of the variation of the attitude has been explained by the perceived usefulness, perceived ease of use, compatibility and perceived risk. Therefore, the identified variables have moderately predicted attitude. Furthermore, perceived usefulness has identified as the significant predictor of the attitude (β= 0.501, p-value<0.05), supports H2. It has supported by numerous researches too (Cheon et al., 2012; Tagoe and Abakah, 2014; Ismail and Hosseini, 2014; Lai, 2017; Yang and Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Nadlifatin et al., 2020; Wang et al., 2020; Gao, 2020; He et al., 2020; Alfadda and Mahdi, 2021; Purwanto and Tannady, 2020; Bhatt and Shiva, 2020; Kim et al., 2021). Thus, it is critical to ensure that real-time online learning benefits students since this will increase students' positive feelings/attitudes toward real-time online learning. Importantly, it needs to facilitate the enhancement of the knowledge and performance of the students while minimizing the cost and time needed to be spent in real-time online learning. Perceived ease of use has positively associated with the attitude (β= 0.212, p-value<0.05), supports H3, evidenced by (Cheon et al., 2012; Tagoe and Abakah, 2014; Ismail and Hosseini, 2014; Lai, 2017; Yang and Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019). Hence, it is essential to ensure that additional effort is not needed in engaging in real-time online learning. Prominently, the platform under consideration must be simple to use and user-friendly. In the future, developers of applications may consider adding new features such as audio and video aids, simulations to provide a rich learning experience.

Compatibility had the positive effect on the attitude (β= 0.167, p-value<0.05), supports H4. Similar findings were reported in the past studies (Santos and Okazaki, 2013; Ismail and Hosseini, 2014; Lai, 2017; He et al., 2020). Thus, it is needed to understand the individual students' learning style, and the instructor's teaching style needs to be tuned to a certain extent. Further, Adnan and Anwar (2020) emphasized that online learning during the COVID-19 might be problematic specifically to tactile learners. Thus, compatible teaching and learning need to be ensured to increase the positive perception in the mind of undergraduates. Perceived security risk had the significant negative impact on the attitude (β= -0.034, p-value<0.05), supports H5. Similar results were reported in the previous studies too (Lee, 2009; Sanayei and Bahmani, 2012; Liao et al., 2010; Xie et al., 2017). When engaging in real-time online classes, students feel that they may be watched and tracked by some party, which will become the motivation hindering factor later (Kim, 2021). Thereby, Perceived Security Risk on the online platforms will be assumed to be higher. Appropriate security measures therefore need to be ensured in order to increase the positive feeling on the real-time online learning.

74.7% of the variance in the perceived behavioral control has been demonstrated by its identified antecedents namely perceived self-efficacy and facilitating conditions. The study revealed that perceived self-efficacy had the positive effect on the perceived behavioral control (β= 0.507, p-value<0.05), supporting H8 proven by (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe and Abakah, 2014; Lai, 2017; Gomez-Ramirez et al., 2019). This finding shows that as learners' confidence in their ability increases, they may perceive real-time online learning positively. Besser et al. (2020) discovered a discrepancy between student's actual performance and their ideal performance in terms of their expectations and standards. It may be due to the less evaluation of their ability to perform well since they are isolated and distanced from the immediate access of the university. Therefore, it is the prime responsibility of each student to enhance their self-confidence and positive belief in

their ability of themselves. Followingly, facilitating conditions has positively influenced perceived behavioral control (β= 0.400, p-value<0.05), supports H9. The similar results were found in past researches (Lai, 2017; Leejoeiwara, 2013). The students may perceive real-time online learning as it does not require additional effort if they have required technical resources and operative knowledge, and other resources in hand.

Overall, intention to use the real time has been explained with the R2 value of 50.3% by the attitude, perceived behavioral control and subjective norm. Hypotheses namely H1 (β= 0.188, p-value<0.05), H7 (β= 0.312, p-value<0.05) and H6 (β= 0.327, p-value<0.05) were supported. Thus, Attitude (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe and Abakah, 2014; Ismail and Hosseini, 2014; Lai, 2017; Hadadgar et al., 2016; Mangir et al., 2017; Yang and Su, 2017; Khasawneh, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Clutterbuck et al., 2015; Nadlifatin et al., 2020; Ilyas and Zaman, 2020; Gao, 2020; He et al., 2020; Alfadda and Mahdi, 2021; Purwanto and Tannady, 2020; Bhatt and Shiva, 2020; Long and Khoi, 2020), perceived behavioral control (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe and Abakah, 2014; Lai, 2017; Masruf and Teng, 2016; Hadadgar et al., 2016; Mangir et al., 2017; Yang and Su, 2017; Gomez-Ramirez et al., 2019; Clutterbuck et al., 2015; Nadlifatin et al., 2020; Ilyas and Zaman, 2020; Wang et al., 2020; Gao, 2020; He et al., 2020; Ngafeeson and Gautam, 2021) and subjective norm (Cheon et al., 2012; Leejoeiwara, 2013; Tagoe and Abakah, 2014; Lai, 2017; Masruf and Teng, 2016; Mangir et al., 2017; Yang and Su, 2017; Buabeng-Andoh, 2018; Gomez-Ramirez et al., 2019; Clutterbuck et al., 2015; Nadlifatin et al., 2020; Ilyas and Zaman, 2020; Wang et al., 2020; Kim et al., 2021) have the positive effect on the intention to use.

CONCLUSION

The study found a significant impact of Perceived Usefulness on Attitude. Hence, the universities can educate the undergraduates on the benefits of using real-time online learning, and it will help the universities to create positive attitudes among undergraduates towards using real-time online learning. Such positive attitudes can result in adopting real-time online learning more. It may help the universities to overcome poor attendance issues experienced in real-time online learning.

Followingly, Perceived Ease of Use has a significant positive impact on attitude. Students can be educated about how real-time online learning is convenient and easy to use. Thus, university administration can utilize help-desk facilities, training manuals, and video demonstrations to convince the students of the extent to which real-time online learning is easy to use, easy to access, and easy to understand in comparison with traditional learning. These should help to develop positive attitudes towards using real-time online learning. In addition to that, software developers should incorporate new features to make it more user-friendly and convenient to use. Thus, it will result in a positive attitude towards real-time online learning. Additionally, computer hardware and software designers can consider incorporating new features to accommodate the needs of physically disabled students, particularly those who are deaf. As a result, such students will also perceive real-time online learning to be more user-friendly and convenient. It will result in a more favorable attitude toward real-time online learning among these students.

It is discovered that Compatibility has a significant effect on Attitude. It is the prime responsibility of university administration, especially the Internal Quality Assurance Body of each university, to ensure that real-time online learning fits well with students' learning styles. It can be assured by employing frequent feedback mechanisms to assess the extent to which real-time online learning matches with learning style and learning expectation. With the Insights of the feedback, students can be advised through a series of workshops on how learning style needs to be improved to match the idea of real-time online learning. When real-time online learning becomes more compatible with students' learning styles, the positive attitude towards real-time online learning will be improved. Also, insights of the feedback should be communicated with the academic staff to clarify students' learning expectations. Thus, teaching style can be tailored to the learner's expectations. It has the potential to instill a positive attitude toward real-time online learning as it becomes more compatible with the learner's preferred learning style.

The study demonstrated that Perceived Self-Efficacy has a significant impact on Perceived Behavioral Control. With the assistance of the Career Guidance Unit, the university can organize a series of workshops and motivational speeches from experts to help students build their self-confidence. As a result, students

will feel confident working independently in a real-time online learning system. It is not only the sole responsibility of the university to inculcate self-confidence in students. Also, each student must strive to drive up self-confidence and positive belief in their ability to learn via real-time online learning. Therefore, students will feel that real-time online learning is entirely within their control and will use real-time online learning well for their learning activities.

Also, the study has found a significant impact of Facilitation Conditions on Perceived Behavioral Control. Thus, the Sri Lankan government and relevant authorities of the university system must ensure that students have adequate technological resources, operative knowledge, and other required resources for learning. Further, the proposals for establishing computer laboratories in the rural areas, availability of affordable computing devices and internet, and facilities for technical support must be initiated at the university and government level to help the less-privileged students. Consequently, students will feel that real-time online learning is under their control and adopt it for learning activities. Most importantly, the study found a significant effect of Subjective Norm on Behavioral Intention to Use. Hence, there is a need for support from important people, especially friends, family, and academicians, to enhance the adoption of real-time online learning. The university can educate such influential individuals by hosting workshops on their role in students' adoption of real-time online learning. Consequently, with such essential people's positive influence and support, the adoption of real-time online learning will improve.

Limitations

Firstly, this study primarily focuses on Sri Lankan context. As Sri Lanka is a developing nation and online system is not adequately installed and practiced, the framework will be applicable. To enhance the use of this study in developed country the framework needs to be modified in order to cope their needs and challenges. Secondly, future studies can be emerged by combing qualitative and quantitative aspects to have a comprehensive view of student's perspectives of online learning. Thirdly, teacher's perspective can be further added and investigated. Finally, cross sectional studies can be developed in future.

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E-LEARNING STYLES AS A PREDICTOR FOR ATTITUDES TOWARDS DISTANCE EDUCATION: A RELATIONAL RESEARCH WITH THE TEACHER CANDIDATES

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ABSTRACT

Students' attitudes towards distance education can be shaped by the compatibility of their learning styles with this new educational environment. The study aimed to investigate whether various variables and e-learning styles predict student's attitudes towards distance education. The present research was conducted on 387 students enrolled in the education faculty of a state university in Turkiye. The Distance Education Attitude Scale and the E-Learning Styles Scale were used to gather information about participants' gender, preferences for the type of education, monthly internet package, and purposes of internet use. This research is a type of relational research that determines the prediction of relationships between quantitative variables. Stepwise multiple regression analysis was employed in the research. Findings show that the preferred type of education, gender, visual-auditory learning style, and independent learning style predict the attitude toward distance education. In conclusion, this research sheds light on how student-centered distance education models can evolve in the process of digital transformation in education.

Keywords: Distance education, learning, e-learning styles, attitudes, teacher candidates.

INTRODUCTION

The COVID-19 pandemic led to the closure of schools in many countries worldwide. This extraordinary situation highlighted the limitations of traditional face-to-face instruction. To ensure the continuity of education, many institutions began offering remote learning opportunities by adopting education-focused technologies (Can, 2020). The widespread use of distance education and e-learning environments during this process became not just a preference but a necessity. With the proliferation of distance education, there arose a need for research to identify factors influencing learning (Alqurashi, 2019). Regardless of whether students learn face-to-face or remotely, several factors impact the learning process. One of these factors is the learning styles individuals possess. Learning style refers to determining which instructional or study method is more effective in individuals' learning processes (Ozdemir & Kaptan, 2017). Each student has different learning styles based on their characteristics (Ozdemir, 2011). According to Keefe (1979), learning style encompasses cognitive, affective, and psychological behaviors that demonstrate how individuals perceive learning environments, interact with these environments, and respond in such environments. Additionally, Briscoe, Schuler, and Claus (2008) define learning style as an approach that individuals have and are most comfortable with, depending on the culture in which they were raised. Learning style is an inherent trait and remains almost unchanged throughout an individual's life (Kaplan & Kies, 1995). When an individual

recognizes their learning style, they have the opportunity to effectively use it in the learning process. Buckley and Caple (2007) define learning styles as individuals' tendencies to turn to different activities and approaches for learning, emphasizing that these differences are significant factors influencing learning. It is important to consider the teaching methods adopted by students in remote learning environments. Prioritizing these methods by instructors can positively impact students' academic development. There are numerous classifications of e-learning styles in the literature.

Dunn and Dunn (1979) propose that learning styles are based on individual preferences in five areas: a) environment, b) emotionality, c) sociological preferences, d) physiological characteristics, and e) psychological processing inclinations. Felder and Silverman (1988) categorize learning styles into five dimensions: sensory and intuitive, visual and auditory, inductive and deductive, active and reflective, sequential and global. Independent learning involves self-study, social learning involves interactive group activities, visual-auditory learning entails learning by listening to elements such as pictures, tables, graphics, etc., active learning is best done by doing-experiencing, verbal learning is most effective through reading, logical learning involves enjoying activities requiring calculation, and intuitive learning involves associating the learning object with emotions, among other behaviors. In this context, the extent to which current technologies offer options suitable for different learning styles determines the boundaries of students' e-learning styles. In other words, the more reachable the above-classified learning styles are in e-learning, the more learning opportunities there are for students. Barbrow et al. (1996) have stated that a distance education program considering students' learning styles can enhance their achievements and participation. Similarly, in a study evaluating the effects of learning styles in distance education, Binner (1997) demonstrated that encountering materials suitable for different learning styles can enrich students' learning experiences. Furthermore, Ekici (2003) suggested that a distance education program based on students' learning styles can increase learning motivation by promoting more interaction among students. By identifying learners' characteristics and needs, e-learning experiences can be personalized, thereby enhancing learners' performance (Kurnaz & Ergun, 2019). From this perspective, it can be said that students' learning styles are influenced by both internal and external variables, with this influence intensifying on the internal factors in remote education platforms. Therefore, an individual's attitude towards education may have an impact on e-learning. This study investigates the relationship between prospective teachers' e-learning styles and their attitudes towards distance education. The research seeks to answer the question, "Are e-learning styles, gender, preferences for the type of education, monthly internet package, and the most common purposes of internet use predictors of the attitude towards distance education?"

Attitudes are emotional orientations that guide individuals' behaviors. The attitudes teachers possess are among the significant factors that influence the behaviors they exhibit while practicing the teaching profession. The attitudes and behaviors of teachers are crucial for the success of the implemented teaching program. Research conducted on distance education indicates that students' attitudes towards distance education are at a moderate level (Yenilmez et al., 2017; Ekici et al., 2022; Karadag & Yucel, 2020; Yildiz, 2016). Yahsi and Kirkic (2020) stated in their study that those with a good level of technology use also have a high attitude towards distance education.

Researchers investigating the impact of distance education and face-to-face learning environments on student performance emphasize the effectiveness of learning styles in distance education. In their study, Senturk and Cigerci (2018) found significant differences in e-learning styles based on variables such as gender, professional experience, and educational status. They also noted that participants showed a dominance of visual-auditory learning styles. Beadles and Lowery (2007) drew attention to differences in learning styles between students who prefer traditional learning environments and those who prefer web-based learning environments. They highlighted that web-based learning environments are as effective as traditional learning environments but students who prefer web-based learning environments exhibit a more intuitive learning style compared to those who prefer traditional education settings. Ozgur and Tosun (2010) emphasized the positive impact of internet-supported education on e-learning attitudes.

With the onset of the COVID-19 pandemic, the use of e-learning applications in education became widespread, making students' e-learning styles and attitudes towards distance education more crucial for academic success in remote learning environments. In this context, considering e-learning styles in distance education settings is important. However, more research is needed to gain a more detailed understanding of the relationship between e-learning styles and distance education (Heaton-Shrestha et al., 2007). The

insufficient number of studies in the literature explaining the relationship between e-learning style and attitudes toward distance education makes this study even more significant. In this context, the researchers aimed to make a new contribution to the relevant literature.

METHOD

Research Design

This research is a type of relational research that determines and allows the prediction of relationships between two or more quantitative variables without intervening. Although it is possible to show the diversity between variables in relational research, this relationship is not causal. Relational research has two main purposes. The first is to describe relationships between variables, and the second is if there is a sufficiently large relationship between two variables and the score of one variable is known, to predict the score of the other variable (Fraenkel, Wallen, & Hyun, 2012).

Participants

The population of the study consists of 387 teacher candidates enrolled in the education faculty of a state university. The sample size was determined using the Raosoft sample size calculator (http://www.raosoft.com/samplesize.html?nosurvey) with a Confidence Level of 95% and Confidence Interval values of 95% and 5%, respectively. Research data were collected through convenience sampling, a type of non-probability sampling method. In convenience sampling, the researcher begins to form the sample with the easiest accessible respondents (Cohen, Manion & Morrison, 2018). As a result, online access was established with the 387 teacher candidates who volunteered for the study.

Numeric information regarding the characteristics of teacher candidates and the independent variables to be examined in the research are presented in Table 1 below.

Table 1. Descriptive statistics related to teacher candidates and independent variables

Variables	Groups	Frequency	%
Gender	Female	278	71.8
	Male	109	28.2
Type of education preferred	Face-to-face education	317	81.9
	Distance education	70	18.1
Monthly internet package	10GB and below	138	35.7
	11GB-20GB	156	40.3
	21GB and above	93	24.0
The most common purpose of internet usage	Social networks, games, entertainment	210	54.3
	Research-Homework	62	16.0
	Other	115	29.7

It can be observed in Table 1 that the distribution of teacher candidates across the groups is not balanced. Of the study group, 71.8% are female students, 81.9% prefer face-to-face education, 35.7% have an internet package of 10GB or less, and only 16% use the internet primarily for research and assignment purposes. Researchers were inspired by similar studies in the selection of independent variables.

Instruments

In the present study, scores obtained from the Distance Education Attitude Scale were used as a measure of the attitude towards distance education. Additionally, the E-Learning Styles Scale and Personal Information Form were used in the research. The Personal Information Form includes questions related to teacher

candidates' gender, preferences for the type of education, monthly internet package, and the most common purpose of internet use.

The Distance Education Attitude Scale was developed by Kisla (2016) for teacher candidates. The scale consists of 35 items, including 16 negative items. A 5-point Likert-type rating scale was used. Some items from the Distance Education Attitude Scale are as follows: "Distance education reduces student success," and "The lack of continuous face-to-face interaction in distance education bothers me." To determine the construct validity of the scale, Kisla (2016) applied Exploratory and Confirmatory Factor Analysis. The unidimensional scale was found to have an internal consistency coefficient of 0.89. The goodness-of-fit indices for the confirmatory factor analysis of the scale were found to be acceptable, with RMSEA= 0.021, GFI= 0.90, and CFI = 0.93. In the scope of this study, the reliability of the scale was found to be 0.89.

The e-learning styles scale for electronic environments was developed by Gulbahar and Alper (2014) with university students. It consists of seven sub-factors and 38 items, utilizing a 5-point Likert-type rating scale. The sub-factors of the scale include independent learning, social learning, visual-auditory learning, active learning, verbal learning, logical learning, and intuitive learning. Independent learning describes the learning style of individuals who mostly prefer such behaviors as studying on their own and taking responsibility for their learning with some guidance. Social learning represents the learning style of individuals who display such behaviors as engaging in interactive group activities and participating in synchronous activities such as chat, virtual classrooms, or whiteboard applications. Visual-auditory learning is the learning style of individuals who prefer learning with elements such as pictures, tables, and graphics and enjoy learning by listening. Active learning characterizes the learning style of individuals that entails such features as the belief that they learn best by doing, and the enjoyment they derive from exploring or researching. Verbal learning includes the learning style of individuals who think they learn best by reading. Logical learning is the learning style that involves such behaviors as enjoying activities requiring calculation and solving problems through analytical processes. Intuitive learning encompasses the learning style that demonstrates behaviors such as associating the learning object with emotions.

During the development of the scale, Gulbahar and Alper (2014) concluded that the model showed a good fit with the coefficients they obtained from the DFA results, with RMSEA= 0.056, GFI= 0.90, CFI= 0.98. The internal consistency coefficients of the factors of the scale range between .72 and .87. In the present study, the internal consistency coefficients of the factors in the scale were found to be .73 for Independent learning style, .77 for social learning style, .78 for verbal learning style, .74 for visual-auditory learning style, .77 for logical learning style, .61 for active learning style, and 4.9 for intuitive learning style. According to De Vellis (2012), a Cronbach's Alpha (α) coefficient above .70 is considered an acceptable reliability criterion. In scales with fewer than 10 items, low Cronbach's alpha values can be reached. In such cases, an average inter-item correlation ranging between .2 and .4 is recommended (Briggs & Cheek, 1986, cited in Pallant, 2016). In the present study, the correlation average among the items for the active learning style and among the items for the intuitive learning style were found to be .25 and .21, respectively.

Procedure

This research was approved by the Ethics Committee on 03.10.2023 under reference number 2023-8, and the data collection process was conducted by the standards of the Helsinki Declaration (World Medical Association, 2013). The authors have no financial or non-financial competing interests in this Research. All the participants were informed about the purpose of the study, the confidentiality of their voluntary participation, the assurance of keeping their responses confidential, and the collective scientific use of the data. Before responding to the online survey, participants confirmed their consent by approving an informed consent text. The data was collected on 30.10.2023 through an online survey tool accessible from any electronic device (smartphone, tablet, laptop, etc.) via Google Forms.

Data Analysis

Multiple regression analysis is highly sensitive to outliers; hence, data showing outliers should be excluded from the analysis (Pallant, 2016). Mahalanobis distance, one of the techniques used in the detection of multivariate outliers, has been identified. According to the Mahalanobis distance analysis, data from eight sets with chi-square values below p<.001 (Tabachnick and Fidell, 2013) were excluded. In the final state, the 'Mahalanobis Distance Values range between .581 and 19.334. As these values are less than the critical chi-square value for 13 independent variables (*df*=13) and p=0.001, which is 34.53, no outlier problem among the independent variables was revealed. After removing the outliers, the data related to the attitude scale towards distance education was initially examined for normal distribution. The Kolmogorov-Smirnov normality test, skewness, and kurtosis coefficients for the single-factor scale are provided in Table 2 below.

Table 2. Normal Distribution of Data from the Attitude Scale for Distance Education

Scale	Kolmogorov-Smirnov			Skewness	Kurtosis
	Statistic	df	Sig.		
Attitude toward distance education	.044	379	.077	.254	-,229

As can be observed in Table 2, the results of the Kolmogorov-Smirnov test indicate that the data for the attitude scale toward distance education show a normal distribution (p > .05). The Kolmogorov-Smirnov test results for learning styles, which are the independent and continuous variables of the study, did not exhibit a normal distribution. Therefore, the skewness and kurtosis values were examined. These values ranged between -1 and +1. Skewness and kurtosis coefficients within the range of -1 to +1 are considered a measure of the normality assumption (Morgan, Leech, Gloeckner & Barrett, 2004). Thus, it can be stated that the data show a normal distribution. The stepwise multiple regression analysis, an appropriate statistical technique for predictive studies, was utilized. In the study, categorical variables were included in the regression analysis by coding them as "dummy variables," while continuous variables were included in the analysis with their original values. Information about the dummy coding of all variables included in the analysis is provided in Table 3 below.

Table 3. Coding of Dummy Variables

Categorical Variables	Level	Dummy Variable	Coding	Excluded Category
Gender	1. Female 2. Male	Female	Female:1 Male:0	Male
Type of education preference	1. Face-to-face education 2. Distance education	Face-to-face education	Face-to-face education:1 Distance education:0	Distance education
Monthly internet package	Below 10GB 11-20GB 21GB and above	Below 10GB 11-20GB	Below 10GB:1, 11-20GB:0 Below 10GB: 0, 11-20GB:1	21GB and above
The most common purpose of internet use	1. Social networks, games, entertainment 2. Research Homework 3. Other	Social networks, games, entertainment Research Homework	Social networks, games, entertainment:1 Research Homework:0 Social networks, games, entertainment:0 Research Homework:1	Other

The assumptions of multiple linear regression analysis, including normal distribution, linearity, constant variance, absence of autocorrelation, and no multicollinearity among independent variables, were tested (Kalayci, 2009). The assumptions of normality and linearity were examined through graphs depicting the relationships between standardized predicted values and standardized residual values (Figure 1 and Figure 2). According to Figure 1, the histogram and normal distribution curves created for standardized predicted values show a distribution close to normal. According to Figure 2, a linear and positive relationship between variables can be suggested.

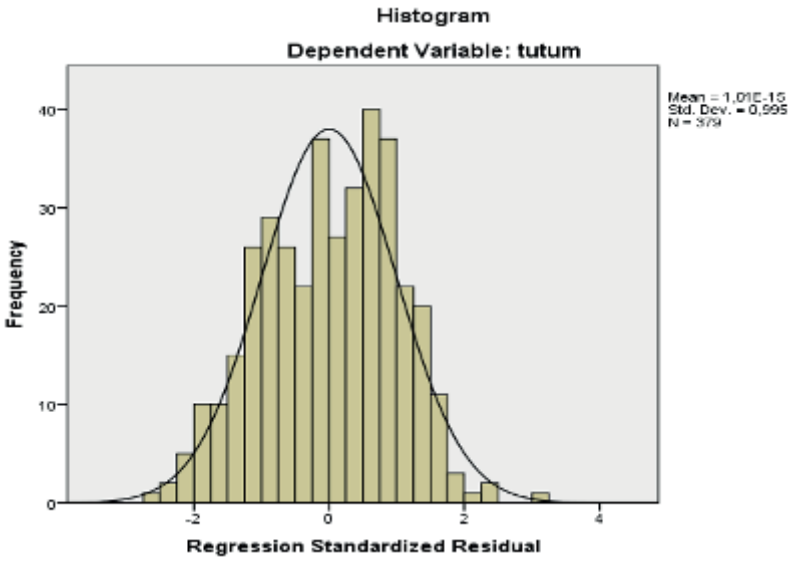

Figure 1. Histogram and Normality Curve of Attitude Data for Distance Education

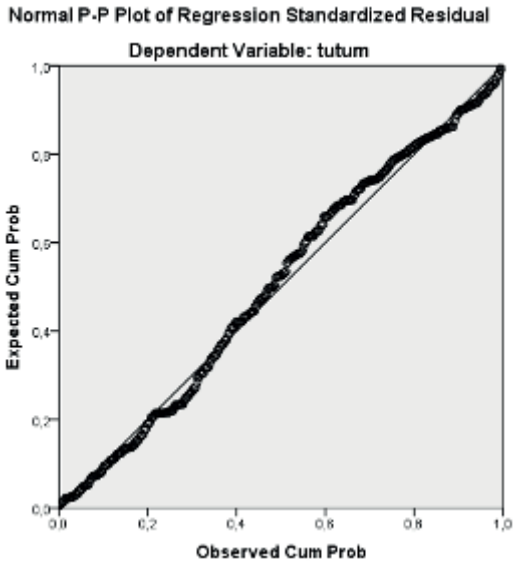

Figure 2. Linearity Distribution of Attitude Data for Distance Education

Upon examination of indicators of multicollinearity among predictor variables, tolerance values were found to range between 0.843 and 1.00, variance inflation factor (VIF) values ranged from 1.00 to 1.187, and the highest condition index (CI) value was found to be 21.546. According to Pallant (2016), to avoid multicollinearity issues in the analysis, the VIF value should be less than 10, and the tolerance value should be greater than 0.10. In this case, it can be concluded that there is no multicollinearity problem. The Durbin-Watson value, used to test autocorrelation, should be less than 1 or greater than 3, indicating the presence

of errors. A value close to 2 is preferable (Field, 2009, p. 236). In this study, the Durbin-Watson value of 2.015 indicates the absence of autocorrelation. The standardized residual value ranges from -2.566 to 3.07. Tabachnick and Fidell (2013) suggest that these values should be between +3.3 and -3.3. The maximum value for Cook's Distance is 0.031. A value below 1 indicates that the data is suitable for regression analysis (Tabachnick & Fidell, 2013).

RESULTS

The results of the multiple regression analysis, conducted using the stepwise model on data related to e-learning styles, which are considered as factors affecting attitude scores towards distance education, including gender, type of education preference, monthly internet package, and the variable of the most common purpose of internet use, are presented in Table 4 below. As can be seen in Table 4, stepwise regression analysis excluded variables that did not significantly predict attitudes towards distance education.

Table 4. Results of Stepwise Multiple Regression Analysis on Variables Predicting Attitudes Toward Distance Education

	Model-Predictive variables	B	Std. Error	Beta	t	Sig.	Partial (r)	Part (R)	R	R^2	F	p
Model 1	(Constant)	3.243	.056		58.182	.000			.552	.305	165.148	.000
	Preferred type of education	-.783	.061	-.552	-12.851	.000	-.552	-.552				
Model 2	(Constant)	3.363	.063		53.087	.000			.575	.330	92.658	.000
	Preferred type of education	-.767	.060	-.541	-12.773	.000	-.550	-.539				
	Gender	-.187	.049	-.160	-3.785	.000	-.192	-.160				
Model 3	(Constant)	3.808	.163		23.332	.000			.588	.345	65.948	.000
	Preferred type of education	-.769	.059	-.542	-12.929	.000	-.555	-.540				
	Gender	-.186	.049	-.159	-3.800	.000	-.193	-.159				
	Visual-auditory	-.115	.039	-.123	-2.953	.003	-.151	-.123				
Model 4	(Constant)	3.580	.179		19.983	.000			.600	.360	52.663	.000
	Preferred type of education	-.754	.059	-.531	-12.763	.000	-.551	-.528				
	Gender	-.191	.048	-.164	-3.952	.000	-.200	-.163				
	Visual-auditory	-.163	.042	-.175	-3.897	.000	-.198	-.161				
	Independent learning style	.105	.036	.133	2.954	.003	.151	.122				

As can be seen in Table 4, in the regression analysis, when the predicting variables are gradually introduced into the model, four models are formed. In the first model, the predicting variable is 'preferred type of education,' while in the second model, the variable 'gender' is added. In the third model, the visual-auditory learning style is introduced, and finally, in the fourth model, the independent learning style is added. Examination of the t-test results in the regression analysis suggests that all variables entering the equation are predictors of attitudes toward distance education. When binary and partial correlations are examined, the type of education (r = -.55) shows a moderate, while gender (r = -.20) and visual-auditory learning style (r = -.20) demonstrate a low and negative relationship with attitudes toward distance education. A low-level and positive relationship (r = -.15) is observed between independent learning style and attitudes toward distance education. When other variables are controlled, the relationships are observed to largely remain unchanged.

Model 4 reveals that all four variables are significantly included according to their beta values. In order of importance (based on beta values), the preferred type of education (beta=-.531, p<.01) contributes the most,

followed by visual-auditory learning style (beta=-.175, p<.01), being female (beta=-.164, p<.01), and finally, independent learning style (beta=.133, p<.01). In the final model, these four variables together account for 36% of the total variance in attitudes toward distance education, F(4.374)= 52.663, p<.01

DISCUSSION

According to the research findings, four variables have proven to be effective in predicting attitudes toward distance education. The preferred type of education, gender, visual-auditory learning style, and independent learning style predict attitudes toward distance education. In a series of studies, it has been emphasized that students' learning styles should be considered in distance education (Yinanc & Ozudogru, 2023) and that e-learning styles have a positive impact on student achievement and attitude (Kurnaz & Ergun, 2019; Tulbure, 2011). Furthermore, it has been suggested that a distance education program designed based on students' learning styles enhances student satisfaction and promotes success (Dille and Mezack, 1991), fosters more interaction among students, and increases learning motivation (Ekici, 2003). These findings indicate that considering individual differences in distance education can have a positive impact on student achievement and satisfaction.

According to the results obtained in the research, a moderate and negative relationship has been identified between students' preference for face-to-face education and their attitudes toward distance education. This situation indicates that students who prefer face-to-face education may have hesitation or a negative perception toward distance education. At the same time, the prediction of distance education by the preferred type of education suggests that students' educational preferences have an impact on distance education. Consistent with these findings in the literature, numerous studies are emphasizing that distance education may not be as effective as face-to-face education, and studies revealing negative attitudes and opinions toward distance education (Karatepe et al., 2020; Karakus, et al., 2020; Rizun & Strzelecki, 2020; Sutiah et al., 2020; Syauqi et al., 2020; Unger and Meiran, 2020). Adversities experienced in distance education can contribute to student dissatisfaction (Arbour, Kaspar & Teall, 2015; Devran & Elitas, 2016; Illarionova et al., 2021; Karakus, et al., 2020; Karakus & Yanpar-Yelken, 2020; Keskin & Ozer-Kaya, 2020; Runtic & Kavelj, 2020; Terzi, 2021; Yagan, 2021; Yildiz, 2016). These challenges may make face-to-face education more appealing and increase students' confidence in traditional teaching methods. Therefore, educational institutions producing solutions to address the challenges encountered in distance education can potentially redirect students' negative attitudes towards distance education in a positive direction. Additionally, the research emphasizes the advantageous aspects of distance education, such as providing time and space flexibility, ensuring equal opportunities, enabling ample review opportunities, facilitating access to more information, and reducing costs (Joosten and Cusatis, 2020; Harsasi, 2015; Ozgol, Sarikaya & Ozturk, 2017). These findings indicate that the alternative options offered by distance education should not be overlooked. Hybrid education can be used to overcome the disadvantages of distance education. Hybrid education provides students with both face-to-face interactive learning opportunities and the chance to benefit from the advantages of distance education (Linder, 2017). Courses that cannot be effectively delivered through distance education or have low efficiency can be supplemented with face-to-face education.

In the study, a negative and low-level relationship was found between the gender of teacher candidates and their attitudes toward distance education. Additionally, gender was identified as a predictor of attitudes toward distance education. The negative trend in the attitudes of female teacher candidates suggests the need to consider gender-based differences in distance education. Tufekci-Aslim & Saracoglu (2023), Park (1997), and Dunn et al. (1993) found gender differences favoring female students in their research. In this regard, it is important for educators and policymakers to develop supportive strategies for fostering a more positive attitude towards distance education, especially among female teacher candidates. In a recent study, Armstrong-Mensah et al. (2020) emphasized that gender statistically did not have a significant impact on students' views on distance education. The findings of other studies in the literature indicate that students' gender does not create a significant difference in their attitudes toward distance education (Al Salman et al., 2021; Akoglu, 2022; Altuntas-Yilmaz, 2020; Bicer & Duruhan, 2014; Coskun & Demirtas, 2014; Celik, 2017; Hasturk & Ozdemir, 2021; Irwanto, Cahyana & Ayuni, 2024; Isikli, 2017). Therefore, more comprehensive studies considering student profiles, cultural differences, educational levels, and other variables are needed at this point.

The study determined that there is a negative and low-level relationship between teacher candidates' adoption of visual-auditory learning style and their attitudes towards distance education. Additionally, the results indicate that the visual-auditory learning style is a predictor of attitudes towards distance education. These findings suggest that learning styles, particularly those based on visual-auditory preferences, can influence students' attitudes towards distance education. Other studies in the relevant literature also reveal variations in visual-auditory preferences (Akturk, 2014; Ates & Altun, 2008; Birdal, 2022; Bilasa, 2015; Carrier, 2009; Dobson, 2010; Saban & Arslahan, 2015; Urval et al., 2014).

Unlike other predictive variables, it was determined that there is a positive and low-level relationship between teacher candidates' possession of an independent learning style and their attitudes towards distance education. Additionally, the independent learning style was identified as a predictor of attitudes toward distance education. This positive relationship between teacher candidates' independent learning styles and their attitudes toward distance education may reflect a transition towards personalized learning in education. Various studies emphasize that students' positive attitudes toward distance education are positively related to independent learning styles (Alsan, 2009; Aydemir, Kocoglu & Karali, 2016; Dunn et al., 1990; Senturk & Cigerci, 2018). In this context, it can be claimed that students actively involved in distance education environments tend to manage their learning more effectively (White, 2005). Since attitudes may vary throughout the academic year, collecting data for a specific period may be insufficient. Therefore, new research on attitudes toward distance education is needed.

CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

The research results indicate that the preferred type of education, gender, visual-auditory learning style, and independent learning style predict attitudes toward distance education. The low-level relationship between e-learning styles and attitudes toward distance education may be attributed to instructional staff conducting only (PowerPoint) presentations in lessons, failure to ensure student participation, and the students being passive listeners. Additionally, the absence of other cognitive factors such as motivation and self-regulation that could be effective in learning through distance education might have influenced the results. Studies in which these factors are controlled can be recommended for future research. Furthermore, researchers could explore the impact of a distance education course prepared by e-learning styles on attitudes toward distance education. Another important factor to consider in future research is the rapid advancement of educational technologies and the development of new instructional materials. These factors can significantly impact the experience of distance education. Therefore, a more detailed examination of students' adaptation processes to technology, and the use of different learning platforms and their interaction features can assist in determining more effective strategies in the design of future distance education practices.

While the majority of participants in the study were female students, the proportion of male students was relatively low. Additionally, the use of a convenient sample in this research prevents the generalization of the results (Emerson, 2021). This situation indicates that the findings are based on a specific sample and therefore cannot be generalized. In future studies, using a larger and more diverse sample, conducting research designed to include participants from different age groups, socioeconomic levels, and geographical regions can enhance the generalizability of the findings. Despite these limitations, our study provides a valuable contribution to understanding how students' e-learning styles and attitudes toward distance education may vary based on different demographic factors. In conclusion, while shedding light on recommendations for future research, these limitations prompt a careful evaluation of the findings and interpretations of the current study.

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