Contents lists available at GrowingScience

International Journal of Data and Network Science

homepage: www.GrowingScience.com/ijds

The importance of effective learning technology utilization, teacher leadership, student engagement, and curriculum in the online learning environment

Mohammed Al Matalka[a], Firas Tayseer Mohammad Ayasrah[b], Hani Yousef Jarrah[c], Malik Jawarneh[d], Bashar Younis Alkhawaldeh[e], Saddam Rateb Darawsheh[f*] and Haitham Rizk Fadlallah[g]

[a]*Rabdan Academy, United Arab Emirates*
[b]*College of Education, Humanities and Science Al Ain University, United Arab Emirates*
[c]*Al Ain University, United Arab Emirates, College of Education, Humanities & Social Sciences, United Arab Emirates*
[d]*Oman College of Management and Technology, Oman*
[e]*Assistant Professor, Department of Administrative Sciences, Faculty of Business, Jerash University, PO. Box 26150, Jordan*
[f]*Assistant Professor. Department of Administrative Sciences, The Applied College, Imam Abdulrahman Bin Faisal University, Jordan*
[g]*Network Department Faculty of Information Systems and Computer Science, October 6 University Cairo, Egypt*

C H R O N I C L E

Article history:
Received: November 26, 2023
Received in revised format: January 18, 2024
Accepted: February 24, 2024
Available online: February 24, 2024

Keywords:
Learning Technology Utilization
Teacher Leadership
Student Engagement
Curriculum

A B S T R A C T

Research has shown the effect of student engagement, teacher leadership, and curriculum on the effectiveness of the use of learning technologies and the online learning environment. The study included a total of 382 samples that included both teachers and students. Survey respondents are qualified teachers with at least 10 years of teaching experience, as determined through sampling. Participants responded to a study questionnaire that was used to collect data. Data were collected using Smart PLS software, which included validity and reliability assessments and hypothesis tests. The results of the study indicated that the dissemination of learning technology is directly affected by teacher leadership and student participation, which affects its effectiveness. Instructor leadership, student engagement, and successful use of learning technologies directly impact the online learning environment. The use of learning technology is influenced by teacher leadership, curriculum, and student engagement, which ultimately impacts the online learning environment. This study suggests two main results. To enhance the efficiency of learning technology deployment, the focus of public policy should be on enhancing teacher leadership and student performance. Moreover, enhancing the efficient use of learning technology is a critical policy goal to improve the quality of the online learning environment. Students and teachers with enhanced skills should collaborate to share their technological learning materials and management practices to improve students' online learning experiences. Subsequently, modifications were made to the curriculum and there was an increase in teacher leadership.

1. Introduction

Online learning, as defined by Tallent-Runnels et al. (2006) is the use of communication technologies, such as the Internet, to provide education to geographically separated students. Online learning can be classified into synchronous and synchronous modalities. Synchronous online learning is a form of education in which students and teachers can engage in flexible learning activities without having to be online simultaneously (Hrastinski, 2008). This learning is usually facilitated by a learning management system and other electronic tools to provide lessons in a flexible way to students who suit them. (Hutton et al., 2020). Synchronous online learning is a form of education in which both teachers and students are required to be present

* Corresponding author.
E-mail address: srdarawsehe@iau.edu.sa (S.R. Darawsheh)

ISSN 2561-8156 (Online) - ISSN 2561-8148 (Print)

doi: 10.5267/j.ijdns.2024.2.015

simultaneously to participate via videoconferencing (Hrastinski, 2008). Videoconferencing outlets are used to facilitate real-time online learning (Hutton et al., 2020). The literature has shown the benefits of online learning in facilitating the engagement of learners in the social and cognitive aspects of knowledge construction (Quek, 2009; Voogt et al., 2018). The use of technology, such as Google SpaceWorks, enables this goal to be achieved through interactions and collaboration (Choy & Quek, 2016). However, online learning also poses some problems, as highlighted in some publications. Teachers emphasized concerns about decreased student concentration during virtual learning (Raja & Nagasubramani, 2018; Sandars, 2012). Teachers face distress when they are forced to adopt and integrate Internet teaching into their teaching practices. Due to the Covid-19 pandemic, educators were forced to quickly adapt their teaching methods to incorporate technological tools (Dhawan, 2020). Teachers face the challenge of navigating through numerous digital resources on the Internet, making it difficult for them to choose and use the most appropriate tools for their classrooms (Sabarinath & Quek, 2020). This experience has prompted teachers to reconsider their teaching methods, resource selection, lesson plans, and classroom dynamics. Students face difficulties in their online learning because they often consider it boring and lacking motivation, especially when their social requirements are neglected in the digital environment (Dhawan, 2020). Currently, there is a paucity of available literature on online learning in secondary schools. The research focuses mostly on higher education.

According to Berg et al. (2014), teachers have gradually begun to occupy a major leadership position in schools, and their role in promoting education has become indispensable in recent decades. The validity of this study was confirmed by Akert and Martin (2012), which confirmed that teacher leadership had an impact on student knowledge and enhanced the level of learning. Implementing teacher leadership as a strategic approach to improve the environment of schools by harnessing the potential of teachers (Cheng & Szeto, 2016). The role of teacher leadership is essential in enabling online learning facilities and curricula to effectively facilitate the implementation of environment online learning. The curriculum serves as an indispensable framework and educational compass for all educational endeavors within schools.

The curriculum constitutes an indispensable framework and guiding principle for all educational endeavors within schools. The curriculum provides teachers with the knowledge and skills necessary to fulfill their obligations and responsibilities and enables them to teach more effectively. The curriculum is essentially an organized framework for teaching and learning. Considering the Coronavirus Disease 2019, the nationwide curriculum must be updated to adequately handle the challenges and vicissitudes encountered during the learning process. The curriculum should be modified to meet the requirements of the present era by introducing technical advances. Online learning is a prerequisite for education during the COVID-19 pandemic. These days, it is necessary to develop the curriculum in a creative and forward-looking manner in order to keep pace with the latest developments in the industry. The curriculum should provide practical suggestions that can be easily implemented as adaptable guidelines for learning. According to Looi et al. (2014), their research showed that introducing modifications to the curriculum had an optimistic and helpful influence on the implementation of novelty. This has a significant influence on changing the behavior and attitudes of teachers, as well as on the implementation of educational systems that use technological tools known as online learning. McKim and Barrow (2009) supported this perspective, emphasizing that the main goal of the curriculum is to create a structure or plan that enables a productive and streamlined learning experience.

Student engagement in online learning refers to students' active participation in using online learning platforms for educational purposes, including their behavioral, cognitive, and emotional engagement (Hu et al., 2016). Students' participation in online learning is not only affected by their behavioral behavior such as reading educational materials, asking questions, participating in interactive activities, and performing tasks, but also by their cognitive performance (Lee et al., 2015). In this study, cognitive behavior refers to all the mental processes that allow pupils to make connections, evaluate, and reflect on an event to gain knowledge afterwards. Moreover, cognitive behavior is closely linked to an individual's intellectual ability and competence. For example, during activities such as studying, conceptualizing, and problem solving. Student engagement in their behaviors is a critical aspect of online learning, although it poses challenges in terms of accurately defining and accurately representing student efforts. Therefore, it is necessary to consider students' perception, regulation, and emotional support during the learning process (Prabowo et al., 2022). Students are required to actively participate in online learning, which includes both the extent and effectiveness of their participation, connection with peers, intentional learning, help and support from others, as well as self-management and self-discipline.

Technology can facilitate effective e-learning in light of the coexisting Covid-19 pandemic. In order to ensure correct progress in learning, qualified teachers must be responsible for carrying out this learning. One of the basic capabilities that a teacher should possess is experience in the field of educational technology. Teachers with advanced technological proficiency will find it more appropriate to incorporate online learning into their teaching practices. Proficiency in the use of technology is a useful feature to manage the teaching and learning process successfully and efficiently (Gonzalez, 2016). Scrivner (2017) emphasized that our world is turning into a new technological era. To adapt to this change, educators must enhance their technology skills and integrate them into their teaching practices. The effective use of technological tools will achieve the optimal level of student learning, allowing trainers to adapt their teaching methods to the specific needs of each student, as well as to meet the needs of many students (Gonzalez, 2016; Lakshminarayanan & McBride, 2015). According to Harper (2018), technology serves as a new platform for discourse, changing the nature of interaction and communication between professors and students, going beyond the boundaries of online platforms. This enhances the practical nature of the teaching

or learning process, especially the relationships between teachers and students. Hernandez and Morales (2019) emphasized that technology plays a critical role in enhancing teachers' learning, leading to improved learning outcomes and increased student engagement, both of which are key factors in achieving academic success.

The advantages and merits of this research lie in a research model that has not been previously explored. The advantage of this study model lies in the effectiveness of the learning technology use variable, which is considered an intermediary variable. This research has not been done before. It is expected that determining the effectiveness of the use of learning technology as a corresponding factor will demonstrate its very important function between teacher leadership and the online learning environment, between student participation in the online learning environment, and between the curriculum and the online learning environment. Moreover, this study examines the immediate influence of teacher leadership, student engagement, and curriculum on the effectiveness of integrating learning technology. Furthermore, this study examines the specific influence of teacher leadership, curriculum, and the implementation of learning technologies on the online learning environment. It should be noted that no research has previously explored this particular model. This study is called "*The Impact of Teacher Leadership, Student Engagement, and Curriculum on the Online Learning Environment through the Effective Use of Learning Technology*."

2. Literature Review

2.1 Theory of Planned Behavior

The study approach was based on the theory of planned behavior, which served as a comprehensive theoretical foundation. The idea of planned behavior, proposed by Ajzen (1991), assumes that an individual's behavioral modification can be influenced. This theory is used as a basis for studying teacher leadership behaviors, student engagement, adaptation to knowledge skill, and adapting the curriculum to technical developments. These actions can be deliberately strategized and executed, and this behavioral alteration is crucial for optimizing the efficacy of the online learning process as a novel educational strategy in the COVID-19 era. Teachers, being the individuals responsible for guiding classroom instruction, are being tasked with transitioning their teaching approaches from in-person to online platforms. Teachers must possess the ability to readily adjust to educational technology to guarantee the seamless and top-notch execution of online learning.

2.2 The Effects of Teacher Leadership on the Efficiency of Learning Technology Use

Leadership is the action of a leader within an organization, such as an educational institution, who enhances performance by influencing the factors that determine performance (Joseph, 2012; Yukl, 2008). Teacher leadership plays a vital role in the use of educational technology. Consequently, educational institutions have had to make great efforts to disclose teachers' leadership to all individuals involved in education, thus enhancing encouragement and motivation. Instructors' proficiency in using educational technology is essential in an academic setting to enhance professional competence (Joseph, 2012). This will enhance the level of education and students' knowledge acquisition. The use of learning skills is beneficial for students because it facilitates knowledge acquisition and practical application of newly acquired information (Fisher et al., 2012). Teachers are required to effectively guide their modules to facilitate the efficient use of learning technology. The first hypothesis was developed in this study based on previous arguments and research.

H_1: *Teacher leadership influences the efficiency of learning technology use.*

2.3 Student engagement impacts on the Online environment

Research on student engagement has received attention not only in traditional face-to-face classrooms but also in online learning. Student engagement includes students' cognitive engagement, active participation in, and emotional dedication to their learning (Zepke et al., 2009). The level of student engagement in the online environment depends on the learning activities created by professors. Concerning Martin and Bolliger (2018), higher levels of student engagement in online learning led to increased satisfaction and motivation, which leads to increased desire to learn and enhanced performance. To enhance student engagement, teachers should strategically plan their lesson design and provide their students with engaging learning experiences. To create effective online lessons and activities, educators must first understand their students' perspectives, determine what factors will interest them, and then develop a strategy aimed at meeting their learning needs (Dixson, 2010). Research has confirmed that studying students' perceptions can lead to more accurate predictions of their learning outcomes, rather than relying on external observations and teachers' self-evaluations of their teaching practices (Maulana et al., 2015). The views of their educational environment have the greatest influence on students' academic performance and learning behaviors, which accurately reflects their own attitudes and behaviors (Tootoonchi et al., 2016). Furthermore, students' social, psychological, and pedagogical experiences influence how they understand their learning environment (Fraser, 1998). These perceptions, in turn, influence their approaches to learning and ultimately influence the quality of their learning outcomes (Trigwell & Prosser, 1991). There is a paucity of previous research documented in the academic literature regarding students'

perspectives on online participation in a secondary education setting. The two hypotheses were derived from the findings of prior research and the justifications.

H_2: *Student engagement influences the environment of Online learning.*

2.4 The Effect of Curriculum on the Efficiency of Learning Technology Use

The emergence of digital technology has revolutionized the process of acquiring knowledge and developing capabilities. It is necessary to integrate technological advances, especially in the field of educational technology, and make them an integral part of the curriculum (Higgins, 2014). The curriculum requires continuous updates and implementation of a technology-based learning methodology. This phenomenon is observed when a shift in the learning paradigm occurs during the time frame of the COVID-19 pandemic. Improvements in the curriculum are necessary and should be closely linked to technology to promote good progress in the school system (Higgins, 2014; Mohanasundaram, 2018). Connecting curriculum design with innovation is essential for leveraging the full potential of technology. The implementation of curriculum modifications will offer opportunities for advancement in school education and the acquisition of information (Costa & Harris, 2017; Mohanasundaram, 2018). In essence, the curriculum must be synchronized with knowledge skills to facilitate the most effective utilization of knowledge skill. The third assumption was proven based on logic and previous study.

H_3: *The curriculum influences the efficiency of learning technology use.*

2.5 The Influence of Teacher Leadership on the Online Learning Environment

The primary focus in science teaching today should be on instructors. Teachers should strive to enhance students' technological competence (Jeskova et al., 2019; Keengwe & Onchwari, 2009). Teachers' competence in using online learning is a key aspect of the success of learning using technology. The teacher's work in controlling the classroom is essential and cannot be separated from it. The effectiveness of online learning depends on teachers' guidance and supervision in facilitating the learning process. The context of online learning, teachers must show creativity to ensure a high-quality learning experience (Nguyen, 2015). Therefore, every teacher must develop a professional spirit by continuing to enhance his or her knowledge and skills. Teachers must demonstrate a consistent dedication to acquiring knowledge of technological advances on a routine and consistent basis to enhance their teaching and facilitate online learning (Mohamed et al., 2018). Based on previous research results and considering all previous clarifications, the fourth hypothesis was determined.

H_4: *Teacher leadership Influences on the online environment.*

2.2 The Influence Of The Efficacy Of Learning Technology Use On The Environment Of Online Learning

The environment of learning in an online learning environment is strongly influenced by using technology (Masrom, 2007). The use of technology has the potential to change learning behavior in online education, leading to an improved learning experience (Park, 2009). The use of educational technology in conjunction with online learning is considered an appropriate treatment considering the COVID-19 epidemic (Ebner et al., 2020). Efficient management is crucial to online learning approaches. Inadequate administration can have a detrimental impact on student achievement. Hence, it is necessary to use educational technology to provide high-quality online learning. The fifth research hypothesis is developed based on the results of the above-mentioned study and the arguments presented.

H_5: *Learning technology influences the online learning environment.*

2.7 The Impact of Curriculum on Environment of Online Learning

Updating the curriculum in the field of online learning is necessary to meet the demands of all parties concerned. This is the right time to move from traditional education to permanent education. Teachers use online learning, a form of information technology, to deliver educational content to students, thanks to technological advances. Thanks to these technological developments, the educational model has become well known among teachers, students, and the local community as a contemporary educational model (Sun et al., 2008). The use of online learning as a pedagogical approach has a clear impact on enthusiasm, enjoyment, and motivation to acquire knowledge. Hence, this leads to favorable academic achievements of students. Hence, it is imperative to design a syllabus for remote education, as proposed by Lee et al. (2014). The curriculum should be revised to incorporate the utilization of technology for the implementation of online education. Online learning is a crucial part of the curriculum for achieving environmental education (Gotthardt et al., 2006). This study establishes six hypotheses based on rationale and prior research.

H_6: *The curriculum impacts the environment of online learning.*

2.8 Student engagement impacts on the Online environment

Research on student engagement has attracted attention not only in traditional classrooms but also in the field of online education. Student engagement refers to the extent to which students are intellectually engaged, actively involved in, and emotionally committed to their learning (Nasereddin, 2023; Zepke, 2009). The extent of student participation in the online environment depends on the educational tasks that teachers create. According to Martin and Bolliger (2018), when students are more engaged in online learning, they tend to be more satisfied, motivated, and perform better. To improve student engagement, educators should carefully design their lessons and create conducive learning environments for their students. To develop effective online classes and activities, educators need to first understand their students' perspectives, find engaging elements, and then plan carefully to meet their learning needs (Dixson, 2010). Studies have shown that analyzing students' opinions can provide a more accurate prediction of their learning outcomes, rather than relying on external observations and teachers' self-evaluation of their teaching approaches (Maulana et al., 2015). Students' attitudes and behaviors can be accurately evaluated by looking at their perceptions of their learning environment, which has the greatest impact on their academic achievements and learning styles (Tootoonchi et al., 2016). Moreover, students' social, psychological, and pedagogical encounters influence their perception of the learning environment (Fraser, 1998). These views influence their learning practices and ultimately affect the quality of their learning outcomes (Trigwell & Prosser, 1991). There is a paucity of previous scholarly studies on students' perspectives regarding their participation in online activities in the high school context. The seven hypotheses were derived from previous research results and the explanations.

H_7: *The student engagement impacts the environment of online learning.*

2.9 The Influence of Teacher Leadership on the Online Learning Environment via the Efficacy of Learning Technology Use

Teachers play a crucial role in creating the educational environment in the rapidly advancing technological age. Teachers must use technology to revolutionize education, especially educational methodologies. Teachers should be given the authority to adapt the provision of educational assistance according to the specific needs of pupils (Albion & Tondeur, 2018). Teacher leadership plays an important role in enhancing the effectiveness of education, and the quality of teachers is a critical factor in revitalizing the teaching profession (Frost & Harris, 2003). Technology acts as a channel that enhances the role of teachers in facilitating online learning. Technology is just a tool that becomes useless without human intervention. Teachers should be equipped with a comprehensive understanding of various media, capabilities, and limitations to effectively prepare for technology integration. Teachers must actively participate in the process of teaching and learning using technology across multiple disciplines in order to gain this experience (Vrasidas & McIsaac, 2001). The quality of learning can be improved by applying information technology, which in turn supports teachers' leadership (Mumtaz, 2000). Teachers' technology proficiency is crucial to enhancing the frequency of technology-based learning. This would enhance the accumulation of experience in teaching technology and motivate teachers to expand their pedagogical knowledge (Rohaan et al., 2012). The use of technology can effectively eliminate the influence of the quality of trainers on the quality of e-learning. The eight hypothesis was developed based on the results of the previous study and the explanations mentioned above.

H_8: *Teacher leadership influences the environment of online learning through effectiveness of learning technology use.*

2.10 The Influence of Student engagement on Environment of Online Learning through Effectiveness of Learning Technology use

The success of online learning environments depends largely on the level of student engagement. Participation relates to the degree of interest, enthusiasm, and active participation that students show in their learning process. Active students are more likely to use educational tools efficiently. She is exploring a range of digital tools and resources, such as virtual labs, educational apps, and interactive simulations, to enhance her learning experience. When students are highly engaged, they are not just passive recipients of knowledge, but rather active participants using technology. This can improve learning outcomes. Online education often relies on collaborative software, such as forums, chats, and video conferences. Active student participation encourages increased participation in conversations, group collaboration, and peer learning. This connection not only improves their personal learning, but also fosters a more dynamic and supportive learning community. Active students are more likely to actively seek feedback and act accordingly. It uses analytical and evaluative tools to monitor its success and identify areas for improvement. By actively engaging with the topic and using feedback systems, students can gain a deeper understanding and enhance their retention of information. The level of student engagement can influence the design of trainer training courses and the choice of content. Active and engaged students often provide insightful input that can help educators adapt the online learning environment to meet learners' needs more effectively, leading to a more individualized and efficient learning experience (Lee et al., 2015). Active student participation encourages increased motivation and enhances their ability to persevere in the face of difficulties. An interactive, virtual learning platform will enhance student engagement and

commitment to their academic endeavors, especially in the presence of challenging topics or technological obstacles. Ultimately, the degree of student engagement directly affects learning outcomes. Active and engaged students are more likely to achieve educational goals, retain information, and effectively use the knowledge they have acquired in real-life scenarios.

Student engagement is critical to the effectiveness of online learning environments. It facilitates dynamic learning, instills an enabling and collaborative environment, and leads to enhanced educational achievements. Technology is crucial for educators to integrate efficient and user-friendly technological solutions into their online training courses to facilitate and enhance engagement. Based on the results of the previous study and the explanations presented above, nine hypotheses were identified.

H_9: *Student engagement influences the environment of online learning through effectiveness of learning technology use.*

2.11 The Influence of Curriculum on the environment of Online Learning through Efficiency of Learning Technology Use

Bailey et al. (2014) stressed the need of having proficient specialists design the curriculum to ensure its alignment with the utilization of technology. Arias et al. (2016) conducted a study that emphasized the necessity of implementing revisions to educational curriculum materials pertaining to the domains of science and information technology. According to Shahmir et al. (2011), technology is becoming a prominent and influential trend that necessitates adjustments to educational curricula. To enable effective application of online learning during the COVID-19 pandemic, it is necessary to strengthen the curriculum by incorporating technology. The efficiency and effectiveness of the teaching and learning process in the field of online learning can be enhanced by the seamless integration of technology and curriculum. To apply the intended curriculum to online learning, it is necessary to use technology effectively. The curriculum must adapt to contemporary requirements by providing students with a comprehensive understanding of technology (Anderson and Rogan, 2011). Technology plays a crucial role in advancing school curricula towards achieving the desired goals or objectives. Some research confirms that for technology to have a beneficial effect on students, it must be integrated into the curriculum. Transforming the curriculum into an academic strategy that includes all technical educational activities (Jeganathan et al., 2019). In some studies, it was emphasized that technology plays a crucial role in the curriculum, enhancing both teaching and learning. Incorporating technology into the curriculum will ensure that the curriculum is consistent with the educational needs of students today and in the future, providing a more engaging, authentic, and relevant educational experience. In addition, others suggest that integrating the curriculum into technology would enhance the efficiency of online learning. The time assumption was established based on the results of the previous study and the explanations provided previously.

H_{10}: *The curriculum influences the environment of online learning through the effectiveness of learning technology use.*

3. Methods

The participants in this study were composed of students and teachers from secondary schools located in the northern region of Jordan during the year 2024. The number of samples was determined using the Hair method (2015), which indicates that the adequacy of respondents in the study is computed by using a formula ranging from 5 to 10 based on the number of indicators. The selection of respondents depends on selecting appropriate individuals to respond to the research questionnaire. The respondent selection technique used was based on research objectives targeting coaches in leadership roles and qualified educators with at least ten years of experience. The research is based on data obtained from surveys conducted for each teacher as a respondent.

3.1 Types of Research

This paper employs quantitative techniques, namely the use of a structural equation model. This hypothesis is being validated using the SmartPLS program. This study investigates the link between a single variable, specifically the dependent variable, and an independent variable. The study aims to empirically validate the hypotheses drawn from the theoretical framework and the previous study's findings. Depending on the level of interpretation, this requires performing a descriptive analysis that collects data to test hypotheses, allowing researchers to gain a full and accurate description with a large enough sample size.

3.2 Research Variables

This paper includes five factors: dependent variables, independent variables, and intervening variables. Specifically, the variable adopted in this study is the online learning environment. Online learning refers to the use of information technology for the purposes of teaching and understanding educational topics. Online learning is an educational approach that provides a flexible and personalized form of learning that is both cost-effective and supported by research (Zhang & Nunamaker, 2003). There are three environmental signs of online learning: Online learning is implemented through information technology to meet specific needs. It allows for convenience, flexibility, and efficiency in education (Granger & Levine, 2010).

Moreover, teachers' leadership is the main factor being considered as an independent variable. Teacher leadership refers to the process by which coaches, either individually or as a group, exert influence on their colleagues and other members of the school community with the goal of enhancing teaching methods, student learning, and academic performance (Yukl, 2008; Frost & Harris, 2003). Teacher leadership includes five measurement signs: the extent to which the teacher can through learning, the teacher's accountability for enhancing the learning procedure, the teacher's commitment to continuous improvement, the efforts made to enhance efficiency in online learning, and the teacher's dedication to the professional spirit in the online learning process (Frost & Harris, 2003).

Furthermore, student engagement is considered as the second independent variable. Student engagement in behavior is critically important in online learning, although it poses challenges in terms of accurately defining and comprehensively reflecting student efforts. Therefore, it is necessary to consider students' perception, regulation, and emotional support during the learning process. Students are required to actively participate in online learning, which includes both the extent and effectiveness of their participation, connection with peers, intentional learning, seeking guidance and support from others, as well as managing and monitoring their behavior.

The curriculum acts as a third independent variable. A curriculum is a compilation of educational programs, teaching resources, tools, and educational approaches organized for a specific period of learning (Arias et al., 2016). The curriculum contains three indicators: integrating technology into online learning, preparing teachers in mastering technology, and transforming the learning model through the curriculum and technology module (Belli et al., 2014; Shahmir et al., 2011).

3.3 Hypotheses Testing Stages

The data obtained from the responses to the paper questionnaire were condensed and examined in order to determine the number of respondents, their gender, and their educational background. Data quality assessment was conducted by performing both validity and reliability tests. The purpose of validity testing is to check the accuracy and suitability of the data, as well as to ensure that each statement in the questionnaire accurately represents the variable being studied. Reliability tests are conducted to ensure the consistency of respondents' answers, which indicates the seriousness of research participants. The hypothesis testing process consists of two distinct stages: direct effect testing and indirect effect testing. This study aims to examine seven hypotheses related to direct effects and three hypotheses related to indirect effects (see Fig 1). This hypothesis is being validated using Smart PLS software.

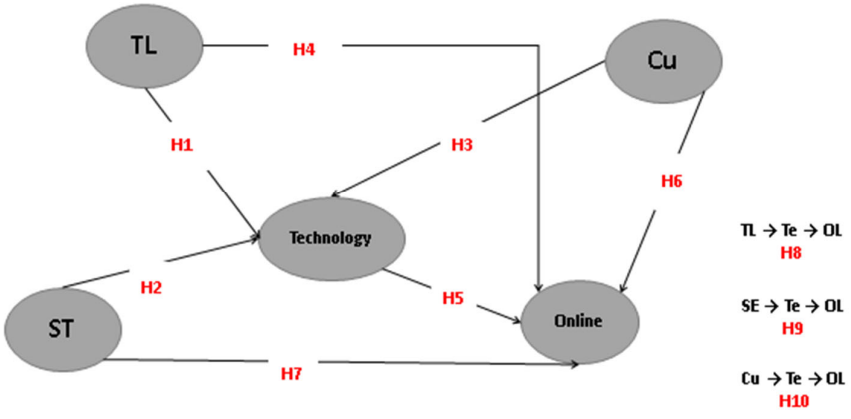

Fig. 1. Research Model

4. Findings

The demographic sample for this study consisted of teachers and students from secondary schools in northern Jordan in 2024, as shown in Table 1. The total number of study participants was 382, consisting of both teachers and students. The number of participants in this study was 217 males and 165 females. Of the 225 students included in the survey, 44 students held a master's degree, 24 students held a diploma, and 89 students held a bachelor's degree. A total of 225 data points were collected. Of these, 132 students use the MLMS for 1-3 hours per day, 65 students use it for less than 3 hours per day, and 28 students use it for more than 3 hours per day.

Table 1
Demographic profile of respondents (N= 382)

Variables	Categories	n
Gender	Male	217
	Female	165
Educational stage	Student	225
	Diploma	24
	Bachelor	89
	Master	44
Students access the LMS	Less than 1 h per day	132
	1–3 h per day	65
	More than 3 h per day	28

4.1 Data Feasibility Test

Evaluate practical applicability of the data presented in this paper by conducting reliability and validity assessments. A validity test is a measure that evaluates the accuracy or reliability of an instrument or instrument. Validity testing evaluates the ability of the questionnaire to accurately measure the intended variables. The validity test is determined by assessing the factor loading of each item with each variable. Table 2 displays the validity test results. All variables have factor loadings above 0.5, indicating that they are all confirmed as legitimate.

Table 2
Convergent validity results which assure acceptable values (Factor loading, Cronbach's Alpha, composite reliability, Dijkstra-Henseler's rho > 0.70 & AVE > 0.5).

Constructs	Item	Factor loading	Cronbach's Alpha	CR	AVE
Teacher Leadership (TL)	TL1	0.756			
	TL2	0.858	0.851	0.834	0.645
	TL3	0.720			
Student Engagement (SE)	SE1	0.744	0.824	0.820	0.682
	SE2	0.895			
	SE3	0.794			
	SE4	0.752			
Curriculum (Cu)	Cu1	0.885	0.869	0.859	0.710
	Cu2	0.820			
	Cu3	0.751			
	Cu4	0.801			
Technology (Te)	Te1	0.800			
	Te2	0.838	0.832	0.844	0.728
	Te3	0.750			
Online learning environment (OL)	OL1	0.825	0.870	0.855	0.711
	OL2	0.821			
	OL3	0.848			
	OL4	0.832			

This result indicates that the tool used in the research questionnaire is effective and able to accurately represent the variables under study. The concept of teacher leadership, which is measured by four indicators, demonstrates that all elements carry burdens above 0.5. Likewise, student engagement consists of four indicators, all of which have a factor loading greater than 0.5. In addition, the curriculum consists of four indicators, all of which have a loading value exceeding 0.5. There are three indicators that determine the effectiveness of technology use, all of which have a factor loading of more than 0.5. The direct computer learning environment variable consists of four indicators, each of which has a factor loading exceeding 0.5. The results shown in Fig. 2 indicate that the coefficient of determination of curriculum, student engagement, and teacher leadership in relation to the effectiveness of the use of learning technology is 0.422, which is equivalent to 42.2 percent. This indicates that 57.8 percent of the choices related to additional variables could affect the effectiveness of the use of learning technologies. When comparing teacher leadership and curriculum, curriculum has a much greater impact on the success of learning skill use, particularly by a factor of 0.487. A 100 percent increase in curriculum application will improve the use of knowledge technology by 48.7 percent. According to this model, strengthening the curriculum is the main priority to increase the efficiency of the use of knowledge skills. Subsequently, the scope of strengthening teachers' capacities will be expanded. The coefficient determining teacher leadership, student engagement, curriculum, and effectiveness of using learning technology in the online learning environment is 0.471, which is 47.1 percent. This indicates that the probability of external factors affecting the online learning environment is 52.9 percent. The coefficient of effectiveness of using learning technology had the greatest impact on the online learning environment, reaching a value of 0.422. This was decided after testing three variables. The coefficient indicates that for every 100 percent improvement in the use of learning technology, the online learning environment will see a corresponding increase of 42.2 percent. To enhance the online learning environment, it is crucial to improve the efficiency of the use of knowledge skills, followed by student engagement, instructor leadership, and curriculum. Furthermore, the tests evaluate the reliability of data related to the five variables examined. The test results are shown in Table 2. Various methodologies are employed to assess the dependability of a given entity. Reliability tests include the composite

reliability test, the Cronbach alpha test, and the mean variance extracted test. Data are deemed reliable if both the composite reliability and Cronbach alpha coefficients surpass 0.7, and the extracted average difference is more than 0.5. Based on the outcomes of the data reliability test, it can be inferred that all variables exhibit reliability. The responses to the questionnaire were constantly uniform. The reliable data offered by respondents indicates that they are genuinely contemplating their responses, allowing them to utilize the data for the purpose of conducting physical tests.

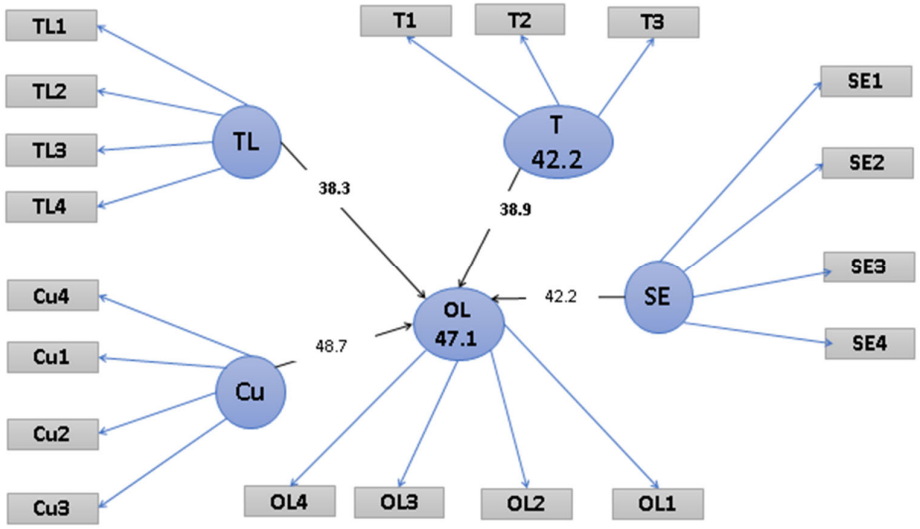

Fig. 2. Validity Test

4.2 Hypothesis Testing

Physics testing is categorized into two main types: direct impact testing and indirect impact testing. A direct causality test was undertaken to scrutinize the seven hypotheses in this study. Consequently, the researchers performed an indirect impact test to investigate the three hypotheses proposed in this study. The subsequent presentation exhibits the outcomes of the direct effect analysis.

Table 3
Direct Effect Test

Variables	Sample mean	Original sample	Standard deviation	t-value	P-value
Teacher Leadership (TL) → Technology (Te)	0.402	0.401	0.089	4.112	0.002
Student Engagement (SE) → Technology (Te)	0.386	0.387	0.076	4.011	0.008
Curriculum (Cu) → Technology (Te)	0.455	0.454	0.065	4.998	0.001
Technology (Te) → Online Learning (OL)	0.546	0.545	0.0901	4.333	0.003
Teacher Leadership(TL) → Online Learning (OL)	0.621	0.622	0.0765	3.001	0.000
Curriculum (Cu) → Online Learning (OL)	0.233	0.0232	0.0984	3.212	0.003
Student Engagement (SE)→ Online Learning (OL)	0.875	0.876	0.897	3.789	0.001

Table 3 provides evidence that enables us to reach some conclusions regarding the direct influence examination. Teacher leadership has a critical role in determining the efficiency of learning skill use. The technical statistic of 4.112 is greater than the critical value of 1.96, indicating statistical significance. In addition, the P value of 0.002 is below the significance level of 0.05, supporting this conclusion. Consequently, the initial assumption in this work has been verified and acknowledged. The findings of this study reinforce and complement research conducted by Yukl (2008), Fisher et al. (2012), Heryanto et al. (2023) and Joseph (2012). The use of learning skills is positively influenced by teacher leadership. Accordingly, any effort to enhance teachers' competence will have a significant influence on the efficiency of the use of learning skills.

Furthermore, testing the direct effect yields the following conclusions. Moreover, the level of student engagement plays a crucial role in determining the efficiency of learning skill use. The T-statistic of 4.011 is greater than the critical value of 1.96, indicating statistical significance. Likewise, the P-value of 0.008 is below the significance level of 0.05, which supports this conclusion. As a result, the second assumption in this investigation was verified and acknowledged. The results of this study reinforce and complement research conducted by Ong and Quek (2023). The use of learning technology becomes more effective when students are actively involved. As a result, every endeavor to enhance student capabilities and engagement will have a significant influence on the efficiency of the use of knowledge skills.

Moreover, the curriculum plays a major role in determining the effectiveness of the use of educational technology. The technical statistical value of 4.998 is greater than the critical value of 1.96, indicating a significant result. Likewise, the P-value of 0.001 is below the significance level of 0.05, providing further support for this conclusion. As a result, the second assumption in this investigation was verified and acknowledged. The results of this study confirm and reinforce the findings of Mohanasundaram (2018), Heryanto et al. (2023), Frost and Harris (2017) and Higgins (2014). Curricula have a beneficial effect on the competence of the use of knowledge skill. Therefore, the effectiveness of the use of learning skills will be enhanced when combined with a curriculum that is seamlessly connected to technology. It is necessary to revise school curricula and integrate learning technology into the implementation of teaching curricula and learning methods. The use of learning skills has a significant influence on the online learning environment. The statistic of 4.333 is greater than the critical value of 1.96, indicating statistical significance. Likewise, the P-value of 0.003 is below the significance level of 0.05, providing further support for this conclusion. Accordingly, the fourth hypothesis in this investigation was verified and acknowledged. The findings of this study confirm and reinforce research conducted by Park (2009), Purwanto et al. (2023) and Ebner et al. (2020). The use of highly efficient learning technologies has a positive influence on the learning environment. Technology is an essential and integral part of the online learning experience. The effective use of learning technologies is crucial to supporting the online learning environment. To enhance the online learning environment, it is necessary to enhance the effectiveness of the use of learning skills.

Teacher leadership has an important influence on the online learning environment. The T-statistic value of 3.001 is more than 1.96, and the P-value of 0.000 is less than 0.05, which supports this conclusion. Accordingly, all five hypotheses presented in this study were verified and acknowledged. The results of this study confirm and reinforce the research conducted by Ješková et al. (2019) and Mohamed et al. (2018). The teacher plays a major role in the educational process. Teacher leadership has a beneficial influence on the online learning environment. Teachers who skillfully guide the education and knowledge development will have a significant influence on the online learning environment. In fact, trainers in this institution must have a comprehensive sympathetic of the pedagogical and cognitive processes involved in online education to leader and guide students efficiently. Teachers have a crucial impact on creating a highly effective learning environment.

The inclusion of sex education in curricula has a profound impact on the virtual learning environment. The T-statistic value of 3.212 is more than 1.96, and the P-value of 0.003 is less than 0.05, which supports this conclusion. Consequently, the gender hypothesis in this study was verified and acknowledged. The results of this study confirm and reinforce research conducted by Li et al. (2014), Assareh and Hosseini (2011), Asbari et al. (2020) and Gotthardt et al. (2006). Curricula have a beneficial effect on the online learning environment. As the level of online learning increases, so does the environment of the curriculum. The curriculum should be adapted to meet the specific requirements of online learning. The curriculum should be adapted to the learning technology used. Integrating technology into curriculum design is crucial for its effective use in online teaching and learning.

Student interaction has a significant impact on the online learning environment. The T-statistic value of 3.789 is greater than 1.96, and the P-value of 0.001 is less than 0.05, which provides evidence in favor of this. Success and acceptance were demonstrated in all five hypotheses presented in this study. The results of this study confirm and reinforce the research conducted by Ješkova et al. (2019) and Mohamed et al. (2018). The teacher plays a major role in the educational process. Active student participation has a beneficial impact on the virtual learning environment. This study presents an instrument that examines various aspects of online learning, such as students' perceptions of course quality, student engagement, online learning technology, overall quality, student factors, institutional factors, instructor characteristics, and satisfaction. These factors have an impact on students' performance. The results of the study show that when tool course quality, student engagement, online learning technology, general quality, and student characteristics are measured on a second-order basis, there are strong values of validity and reliability, supported by an appropriately robust model.

Table 4
The indirect effect results

Variables	Sample mean	Original sample	Standard deviation	t-value	P-value
Teacher Leadership → Technology →Online Learning	0.113	0.211	0.050	2.711	0.009
Student Engagement → Technology → Online Learning	0.201	0.189	0.47	2.678	0.005
Curriculum → Technology → Online Learning	0.209	0.165	0.39	2.333	0.006

The eight hypotheses show that teacher leadership has a direct influence on the online learning environment by influencing the effectiveness of the use of learning technologies. The T-statistic value of 2.711 is more than 1.96, and the P-value of 0.009 is less than 0.05, which supports this conclusion. Accordingly, all eight hypotheses in this investigation were verified and confirmed. The results of this study confirm the findings of Albion and Tondor. (2018), Frost and Harris (2003). The efficient use of learning technology is crucial in the context of teacher leadership and the online learning environment. Using learning technology effectively can serve as a bridge or mediator between teacher leadership and the online learning environment. There is a direct link between the level of effectiveness in using learning technology and the impact of the quality of teachers on the quality of learning. To improve the online learning environment, it is important to go beyond simply improving the

quality of teachers. However, enhancing the efficiency of learning skill use is no less important. This study concluded that the effectiveness of learning skill use can greatly influence the impact of teachers' leadership on the online learning environment.

The nine hypotheses show that student engagement has a direct impact on the online learning environment, that is, in terms of the effectiveness of learning technology use. The T-statistic value of 2.678 is more than 1.96, and the P-value of 0.005 is less than 0.05, which supports this conclusion. Nine hypotheses presented in this study were successfully supported and accepted. The results of this investigation confirm and reinforce the findings of Frost and Harris (2003), Albion and Tondor (2018). The efficiency of the use of learning skills is crucial, as it depends on student engagement and the online learning environment. Using learning skills effectively can link or mediate student engagement and the online learning environment. To enhance the online learning environment, it is necessary to go beyond simply improving the quality of students. However, enhancing the efficiency of education technology use is no less significant. This study showed that the effectiveness of learning skill use can greatly influence the impact of student engagement on the online learning environment. Students who feel content while engaging in an online learning system will make efforts to have commendable academic performance.

The ten hypotheses can be clarified by observing how the curriculum affects the environment of online learning by evaluating the efficiency of the use of learning skills. The statistical value of 2.333 is higher than the critical value of 1.96, indicating statistical significance. Likewise, the P value of 0.0060 is below the significance level of 0.05, which supports this conclusion. Accordingly, all ten hypotheses in this investigation were verified and acknowledged. The findings of this study reinforce and complement research conducted by Shahmir et al. (2011), Anderson and Rogan (2011), Arias et al. (2016), Bailey et al. (2014), Jeganathan et al. (2019). Crucial in this regard are the curriculum, the extent of online learning, and the efficiency of the use of learning skill. Curricula indirectly affect the level of online education. The curriculum indirectly affects the environment of online learning through the in an effect use of education skills. The results of this study provide an alternative solution to improve the quality of online learning. This can be achieved by enhancing the efficient use of learning skill and refining the quality of the curriculum.

5. Conclusion and Discussion

The findings of this inquiry encompassed research investigations. Research also influences education administrators and regulators, particularly the Ministry of Education and the Jordanian government. Initially, this study showed that the effectiveness of learning technology use is influenced by teacher leadership, student engagement, and curriculum. The curriculum has a greater influence on the efficiency of learning skills than student engagement and teacher leadership. If you aim to enhance the efficient use of learning skills, it is crucial to prioritize curriculum improvement and modification. This is of great importance to school principals and administrative authorities. The indication of this is related to that. A basic requirement is the development of a comprehensive national curriculum that includes the use of educational technologies. The government can provide training and assistance to educators in revising the curriculum. Integrating curricula and learning technologies currently remains and will continue to be a necessity. During the Coronavirus Disease 2019, it is not just a transitional decision. Despite the rapid spread of Coronavirus Disease 2019, the integration of skill into education has accelerated. Furthermore, the online learning environment is influenced by teacher leadership, student engagement, curriculum, and the effectiveness of learning technologies. One of the three factors is the influence on the environment of online learning using education technologies. The results of this study indicate that institutional administrators and education administrators should prioritize enhancing the effectiveness of learning technology in order to enhance the online learning environment. Using learning technology efficiently can enhance teacher leadership, update curricula, and improve student skills. The government must prioritize the equitable distribution of online learning support services across all regions of Jordan.

Teachers who lack understanding of learning technologies need more education. Furthermore, research has demonstrated that the deployment of learning technology significantly impacts the online learning environment, including teacher leadership and curriculum. The online learning atmosphere is influenced by both leadership and curriculum, which have a direct impact as well as an indirect impact through the efficiency of the use of education skills. This material is useful for directors of educational institutions. To enhance the online learning environment, it is necessary to focus not only on enhancing teacher leadership and curricula, but also on other factors. Enhancing the application of learning technology is likely to improve the online learning environment. The impact of online learning on the environment is influenced by the effectiveness of learning technologies, as well as the management of teachers, students, and curricula.

This study confirms the acceptability of the methodology used to evaluate students' learning performance in schools that adopt online learning technologies. The results of this study provide valuable insights for schools and educators to enhance student learning outcomes. This model will provide guidance in achieving concrete national educational goals or helping to strengthen the existing system. From the educator's perspective, it facilitates the development of educational materials that are efficient and adapted to meet the needs of the students. The schools aim to enhance the existing e-learning system to stimulate graduates who possess the necessary skills to excel in the professional field.

Based on the results of this study, it is necessary to conduct a discussion and make recommendations. The use of curricula has the greatest influence on the implementation and efficiency of teaching and education skill. The issue at hand is the suitability of the online learning approach in the context of the current COVID-19 pandemic. What is the right software to provide mobile learning? It is necessary to prove this. Alternative solutions to the take-off dilemma within the epidemic will be discovered. Furthermore, the effectiveness of learning technology deployment is influenced by teacher leadership. E-learning is influenced by teacher leadership. To benefit from online learning properly, teachers must have some level of expertise in instructional design. This statement remains unverified. It is necessary for more researchers to participate in this work. Moreover, this study only evaluates the quality of e-learning based on inputs and processes, without taking into account other factors. Despite the limitations and effectiveness of current technological infrastructure, what about the level of e-learning? Additional investigation into this issue is still necessary.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Akert, N., & Martin, B. N. (2012). The role of teacher leaders in school improvement through the perceptions of principals and teachers. *International journal of education*, *4*(4), 284. https://doi.org/10.5296/ije.v4i4.2290

Albion, P. R., & Tondeur, J. (2018). Section introduction: Professional learning and development of teachers. *Second handbook of information technology in primary and secondary education*, 1-3.

Anderson, T. R., & Rogan, J. M. (2011). Bridging the educational research-teaching practice gap: Curriculum development, Part 1: Components of the curriculum and influences on the process of curriculum design. *Biochemistry and molecular biology education*, *39*(1), 68-76. https://doi.org/10.1002/bmb.20470

Arias, A. M., Bismack, A. S., Davis, E. A., & Palincsar, A. S. (2016). Interacting with a suite of educative features: Elementary science teachers' use of educative curriculum materials. *Journal of Research in Science Teaching*, *53*(3), 422-449. https://doi.org/10.1002/tea.21250

Asbari, M., Wijayanti, L., Hyun, C. C., Purwanto, A., Santoso, P. B., Bernarto, I., & Fayzhall, M. (2020). The role of knowledge transfer and organizational learning to build innovation capability: Evidence from Indonesian automotive industry. *International Journal of Control and Automation, 13*(1), 319-333.

Assareh, A., & Bidokht, M. H. (2011). Barriers to e-teaching and e-learning. *Procedia Computer Science*, *3*, 791-795. https://doi.org/10.1016/j.procs.2010.12.129

Bailey, A. L., & Heritage, M. (2014). The role of language learning progressions in improved instruction and assessment of English language learners. *Tesol Quarterly*, *48*(3), 480-506.

Belli, A. M., Reekers, J. A., & Lee, M. (2014). The importance of curriculum-based training and assessment in interventional radiology. *Cardiovascular and interventional radiology*, *37*, 8-10. https://doi.org/10.1007/s00270-013-0750-8

Berg, J. H., Carver, C. L., & Mangin, M. M. (2014). Teacher leader model standards: Implications for preparation, policy, and practice. *Journal of Research on Leadership Education*, *9*(2), 195-217. https://doi.org/10.1177/1942775113507714

Cheng, A. Y., & Szeto, E. (2016). Teacher leadership development and principal facilitation: Novice teachers' perspectives. *Teaching and teacher education*, *58*, 140-148. https://doi.org/10.1016/j.tate.2016.05.003

Choy, J. L. F., & Quek, C. L. (2016). Modelling relationships between students' academic achievement and community of inquiry in an online learning environment for a blended course. *Australasian Journal of Educational Technology*, *32*(4).

Costa, C., & Harris, L. (2017). Reconsidering the technologies of intellectual inquiry in curriculum design. *The Curriculum Journal*, *28*(4), 559-577. https://doi.org/10.1080/09585176.2017.1308260

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of educational technology systems, 49*(1), 5-22.

Dixson, M. D. (2010). Creating effective student engagement in online courses: What do students find engaging?. Journal of the Scholarship of Teaching and Learning, 1-13.

Ebner, M., Schön, S., Braun, C., Ebner, M., Grigoriadis, Y., Haas, M., ... & Taraghi, B. (2020). Coronavirus Disease 2019 as Elearning boost? Chronological development and effects at an Austrian university against the background of the concept of "E-Learning Readiness". *Future Internet*, *12*(6), 94. https://doi.org/10.3390/FI12060094

Fisher, T., Denning, T., Higgins, C., & Loveless, A. (2012). Teachers' knowing how to use technology: exploring a conceptual framework for purposeful learning activity. *Curriculum Journal*, *23*(3), 307-325. https://doi.org/10.1080/09585176.2012.703492

Fraser, B. J. (1998). Classroom environment instruments: Development, validity and applications. *Learning environments research*, *1*, 7-34.

Frost, D., & Harris, A. (2003). Teacher leadership: Towards a research agenda. *Cambridge journal of education*, *33*(3), 479-498. https://doi.org/10.1080/0305764032000122078

Gonzalez-Acevedo, N. (2016). Technology-enhanced-gadgets in the teaching of English as a foreign language to very young learners. Ideas on implementation. *Procedia-Social and Behavioral Sciences*, *232*, 507-513. https://doi.org/10.1016/j.sbspro.2016.10.070

Gotthardt, M., Siegert, M. J., Schlieck, A., Schneider, S., Kohnert, A., Groß, M. W., Glowalla, U. (2006). How to successfully implement e-learning for both students and teachers. Academic Radiology. https://doi.org/10.1016/j.acra.2005.12.006

Granger, B. P., & Levine, E. L. (2010). The perplexing role of learner control in e-learning: will learning and transfer benefit or suffer?. *International Journal of Training and Development*, *14*(3), 180-197. https://doi.org/10.1111/j.1468-2419.2010.00351.x

Hair, Jr, J. F. (2015). Essentials of Business Research Methods. Essentials of Business Research Methods. https://doi.org/10.4324/9781315704562

Harper, B. (2018). Technology and teacher–student interactions: A review of empirical research. *Journal of Research on Technology in Education*, *50*(3), 214-225. https://doi.org/10.1080/15391523.2018.1450690

Hernandez-de-Menendez, M., & Morales-Menendez, R. (2019). Technological innovations and practices in engineering education: a review. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, *13*, 713-728. https://doi.org/10.1007/s12008-019-00550-1

Heryanto, H., Tambun, S., Pramono, R., Priyanti, D., & Siregar, I. (2023). E-Learning quality: The role of learning technology utilization effectiveness teacher leadership and curriculum during the pandemic season in Indonesia. *International Journal of Data and Network Science*, *7*(4), 1451-1462.

Higgins, S. (2014). Critical thinking for 21st-century education: A cyber-tooth curriculum? Prospects. https://doi.org/10.1007/s11125-014-9323-0

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educause quarterly*, *31*(4), 51-55.

Hutton, J. S., Dudley, J., Horowitz-Kraus, T., DeWitt, T., & Holland, S. K. (2020). Associations between screen-based media use and brain white matter integrity in preschool-aged children. *JAMA pediatrics*, *174*(1), e193869-e193869.

Jeganathan, L., Khan, A. N., Kannan Raju, J., & Narayanasamy, S. (2019). On a frame work of curriculum for engineering education 4.0. In 2018 World Engineering Education Forum - Global Engineering Deans Council, WEEF-GEDC 2018. https://doi.org/10.1109/WEEF GEDC.2018.8629704

Jeskova, Z., Lukac, S., Kimakova, K., Csachova, S., Ganajova, M., & Kires, M. (2019). In service science teachers' education in the framework of IC Academy project. In ICETA 2019 - *17th IEEE International Conference on Emerging eLearning Technologies and Applications, Proceedings.* https://doi.org/10.1109/ICETA48886.2019.9040090

Ješková, Z., Lukáč, S., Šnajder, Ľ., Guniš, J., Klein, D., & Kireš, M. (2022). Active learning in STEM education with regard to the development of inquiry skills. *Education Sciences*, *12*(10), 686.

Joseph, J. (2012). The barriers of using education technology for optimizing the educational experience of learners. *Procedia-Social and Behavioral Sciences*, *64*, 427-436. https://doi.org/10.1016/j.sbspro.2012.11.051

Keengwe, J., & Onchwari, G. (2009). Technology and early childhood education: A technology integration professional development model for practicing teachers. *Early Childhood Education Journal*, *37*, 209-218. https://doi.org/10.1007/s10643-009-0341-0

Lakshminarayanan, V., & McBride, A. C. (2015). The use of high technology in STEM education. In Education and Training in Optics and Photonics: ETOP 2015. https://doi.org/10.1117/12.2223062

Lee, Y. H., Hsiao, C., & Ho, C. H. (2014). The effects of various multimedia instructional materials on students' learning responses and outcomes: A comparative experimental study. *Computers in Human Behavior*, *40*, 119-132. https://doi.org/10.1016/j.chb.2014.07.041

Looi, C. K., Sun, D., Wu, L., Seow, P., Chia, G., Wong, L. H., ... & Norris, C. (2014). Implementing mobile learning curricula in a grade level: Empirical study of learning effectiveness at scale. *Computers & Education*, *77*, 101-115. https://doi.org/10.1016/j.compedu.2014.04.011

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online learning*, *22*(1), 205-222.

Masrom, M. (2007). Technology acceptance model and E-learning. 12th *International Conference on Education*.

Maulana, R., Helms-Lorenz, M., & van de Grift, W. (2015). A longitudinal study of induction on the acceleration of growth in teaching quality of beginning teachers through the eyes of their students. *Teaching and Teacher Education*, *51*, 225-245.

McKimm, J., & Barrow, M. (2009). Curriculum and course design. *British Journal of Hospital Medicine (2005)*, *70*(12), 714-717. https://doi.org/10.12968/hmed.2009.70.12.45510

Meyer, M. W., & Norman, D. (2020). Changing Design Education for the 21st Century. She Ji. https://doi.org/10.1016/j.sheji.2019.12.002

Mohamed, A., Razak, A. Z. A., & Abdullah, Z. (2018). Teacher leadership and teacher professional learning in schools of-Maldives. *International Online Journal of Educational Leadership*, *2*(2), 36-50. https://doi.org/10.22452/iojel.vol2no2.4

Mohanasundaram, K. (2018). Curriculum design and development. *Journal of applied and advanced research*, *3*(1), 4-6. https://doi.org/10.21839/jaar.2018.v3is1.156

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of information technology for teacher education*, *9*(3), 319-342. https://doi.org/10.1080/14759390000200096

Nasereddin, A. Y. (2023). Impact of the Blue Ocean Strategy Dimensions in Achieving Competitive Advantage from the Perspective of Faculty Members.

Nguyen, T. (2015). The effectiveness of online learning: Beyond no significant difference and future horizons. *MERLOT Journal of online learning and teaching*, *11*(2), 309-319.

Ong, S. G. T., & Quek, G. C. L. (2023). Enhancing teacher–student interactions and student online engagement in an online learning environment. *Learning Environments Research*, 1-27.

Park, S. Y. (2009). An analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning. *Journal of Educational Technology & Society*, *12*(3), 150-162.

Prabowo, H., Ikhsan, R. B., & Yuniarty, Y. (2022, November). Student performance in online learning higher education: A preliminary research. In *Frontiers in Education* (Vol. 7, p. 916721). Frontiers.

Purwanto, A., Purba, J.T., Bernarto, I., Sijabat, R.(2023). Investigating the role digital transformation and human resource management on the performance of the universities. *International Journal of Data and Network Science, 7*(4), DOI: 10.5267/j.ijdns.2023.6.011

Quek, C. L. (2009). In-service teachers' experiential learning in a Weblog-based environment. *International Journal of Continuing Engineering Education and Life Long Learning*, *19*(2-3), 126-140.

Raja, R., & Nagasubramani, P. C. (2018). Impact of modern technology in education. *Journal of Applied and Advanced Research*, *3*(1), 33-35.

Rohaan, E. J., Taconis, R., & Jochems, W. M. (2012). Analysing teacher knowledge for technology education in primary schools. *International Journal of Technology and Design Education*, *22*, 271-280. https://doi.org/10.1007/s10798-010-9147-z

Sabarinath, R., & Quek, C. L. G. (2020). A case study investigating programming students' peer review of codes and their perceptions of the online learning environment. *Education and Information Technologies*, *25*, 3553-3575.

Sandars, J. (2012). Technology and the delivery of the curriculum of the future: opportunities and challenges. *Medical teacher*, *34*(7), 534-538.https://doi.org/10.3109/0142159X.2012.671560

Scrivner, O., Madewell, J., Buckley, C., & Perez, N. (2017). Augmented reality digital technologies (ARDT) for foreign language teaching and learning. In FTC 2016 - *Proceedings of Future Technologies Conference*. https://doi.org/10.1109/FTC.2016.7821639

Shahmir, S., Hamidi, F., & Bagherzadeh, Z. (2011). Role of ICT in the curriculum educational system. *Procedia Computer Science*, *3*, 623-626.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & education*, *50*(4), 1183-1202. https://doi.org/10.1016/j.compedu.2006.11.007

Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., & Liu, X. (2006). Teaching courses online: A review of the research. *Review of educational research*, *76*(1), 93-135.

Tootoonchi, A., Khoshghalb, A., Liu, G. R., & Khalili, N. (2016). A cell-based smoothed point interpolation method for flow-deformation analysis of saturated porous media. *Computers and Geotechnics*, *75*, 159-173.

Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. *Higher education*, *22*(3), 251-266.

Voogt, J., Knezek, G., Christensen, R., & Lai, K. W. (2018). Information and communication technology and education: Meaningful change through teacher agency. *Second handbook information technology in primary and secondary education*, 381-396. https://doi.org/10.1007/978-3-319-71054-9_25

Vrasidas, C., & McIsaac, M. S. (2001). Integrating technology in teaching and teacher education: Implications for policy and curriculum reform. *Educational Media International*, *38*(2-3), 127-132. https://doi.org/10.1080/09523980110041944

Yukl, G. (2008). How leaders influence organizational effectiveness. *The leadership quarterly*, *19*(6), 708-722. https://doi.org/10.1016/j.leaqua.2008.09.008

Zepke, N. (2009). A future for adult lifelong education in Aotearoa New Zealand: Neoliberal or cosmopolitan?. *International Journal of Lifelong Education*, *28*(6), 751-761.

Zhang, D., & Nunamaker, J. F. (2003). Powering e-learning in the new millennium: an overview of e-learning and enabling technology. *Information systems frontiers*, *5*, 207-218. https://doi.org/10.1023/A:1022609809036