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Impact of Mobile-Learning Technology on Academic Achievement of University Students

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Abstract
In recent years, educators have shown a growing interest in incorporating mobile technologies into their classrooms as a component of the learning experience. The advancement of mobile technology is progressing in both global and local contexts, such as in Pakistan. Mobile devices exhibit a significant departure from conventional computer platforms. This swift transformation, along with the expansion and continuous advancement of modern mobile devices, has opened up a chance for a deeper incorporation of these current devices into educational environments. This paper examines how mobile technology improves students' academic performance and learning attitudes. Mobile learning has gained notable popularity and has attracted heightened research attention. Drawing on insights from Media Richness Theory, the research aims to explore how m-learning pedagogy creates opportunities for student learning and improves their academic outcomes. The results showed that the utilization of mobile devices is highly sought after for delivering M-learning to students and enhances their academic performance. Learning by M-technology has no restrictions; students can obtain knowledge and information anytime and anywhere. M-learning plays a crucial role in creating innovative teaching strategies for higher education learners. M-learning is the future of education, making it essential for students to keep up with evolving technology.
Keywords: M- learning, Technology, Academic, Achievements, Students

Introduction

The use of mobile technology in developing nations has rapidly increased in recent years. In countries like Bangladesh, the Philippines, and Nepal, many people are choosing mobile phones as alternatives to computers and laptops (Mishra & Aithal, 2022; Dey et al., 2019; Alam, 2016). The rise of smartphones has altered the conventional method of utilizing mobile phones. As a result of rivalry among mobile phone manufacturers, prices of mobile devices are falling, and there are advancements in features and software that enhance user creativity as well as learning outcomes. According to Obiadazie and Obijiofor (2015), mobile phones are the most cost-effective means of communication, allowing users to exchange ideas and enhancing their learning compared to computers.

A key advantage of mobile technology is that users can access learning materials regardless of location and time (Mehdipour & Zerehkafi 2013; Ally et al., 2014). Mobile technology offers users learning opportunities, allowing individuals to acquire knowledge without being restricted by their physical location. As technology progresses, mobile devices are becoming smart, more portable, and increasingly powerful (Imgraben et al., 2014). Learners gain expertise using the Internet and mobile platforms to enhance their education

and improve learning (Ahmad, 2024). The increasing trend of using mobile phones for educational purposes is noticeable in developing countries like Pakistan. As per the data released by the Pakistan Telecommunication Authority (PTA, 2017), by the conclusion of April 2017, it was observed that 40.56 million subscribers were engaging with the Internet for communication and learning purposes (Kanwal & Rehman 2017).

Mobile devices have created significant chances for educational institutions to digitalize their teaching methods, enhancing convenience for students (Nikolopoulou, 2022). Nations with collectivistic cultures, such as Turkey, tend to embrace mobile technology for educational purposes more strongly than countries with individualistic cultures, like Canada (Sanakulov & Karjaluoto, 2017). Pakistan is increasingly adopting mobile technology, particularly for learning. Students and teachers now find it exceptionally easy to overcome the challenges of learning and teaching anytime and anywhere. Mobile devices have gained widespread acceptance among students and educators due to their functionality, quality, and principles (Brown & Mbati 2015).

Mobile phones have transformed how students acquire knowledge and enhance their cognitive skills. Mobile technology enhances education by providing access to academic resources, facilitating interaction with peers both locally and internationally, and enabling the exchange of experiences, thereby supporting the learning objectives of individuals and organizations (Pimmer et al., 2016). Mobile technology has diversified educational methods and enhanced collaboration in learning practices (Lindsay, 2016).

Abdekhoda et al. (2023) found a significant positive effect on students' learning and performance through the use of mobile technologies for knowledge sharing and acquisition. Students' motivation to use mobile technology is directly linked to increased academic productivity in Chinese universities. However, some studies have indicated a negative impact of mobile learning on students' performance (Feng et al., 2018; Klimova, 2019; Abachi & Muhammad, 2014).

The use of M-Technology for learning is gaining traction among researchers and policymakers (Keengwe & Bhargava 2014; Abachi & Muhammad 2014). As stated by Roco and Bainbridge (2013), the emergence of new technologies and the world's convergence into a global village lead to swift transformations in human access to information and learning outcomes. New knowledge and information are generated every day, making it essential to enhance our skills. There is a necessity for quick, timely, and easily accessible technologies that assist in enhancing the learning process (Shaikh et al., 2019). M-technology offers users a variety of new chances to access information promptly and acquire new knowledge in their area of interest.

Mobile technology has become recognized as a means of communication and an integral aspect of our social interactions (Merchant, 2012; Vanden, 2016). M-learning refers to the use of smartphones, tablets, laptops, and other portable devices for educational purposes.. M-learning represents an informal and unstructured approach to education. Mobile phones are now used not just for making calls, sending text messages, and MMS, but they also offer numerous advantages to their users. M-technology enables users to access the internet and various useful applications. Currently, mobile technology is extensively utilized in education and is on track to replace traditional educational methods (Martin & Ertzberger 2013; Cassidy et al., 2014).

Most university students consistently possess mobile devices that connect to the internet. During intervals between classes, students often use their mobile phones to send and check a multitude of emails and web pages (Kroski, 2008). In the future, students ought to be allowed to utilize a portion of this time regularly and use mobile technology beyond the classroom. Mobile devices can be a great educational tool since they are easily accessible to students and provide ample support for standard Internet technologies. Enhancing the engagement, interactivity, accessibility, and flexibility of learning for our students is achieved through modern techniques and strategies incorporated into M-learning. M-learning is cost-effective and allows students to learn more without the limitations of traditional approaches. Furthermore, it is easy to keep informed about the latest advancements in educational research (Aguilar et al., 2015).

These technologies assist in developing new educational approaches that allow students to engage in innovative and creative tasks throughout their learning (Tuksanova & Nazarov 2020; Subramani & Iyappan 2018). The integration of communication technology into the educational process is recent, thus requiring ongoing monitoring and enhancement through the acquisition of experience and knowledge in this area. M-technology is currently under development, so it is crucial for teachers to have IT skills to conduct interactive sessions with students (Bombaes, 2018).

A large segment of Pakistan's population cannot access education via conventional schools, which regrettably poses significant challenges for young individuals, particularly girls, in obtaining formal education and personal growth (Ahmad et al., 2014). Many mobile users face challenges, particularly in rural areas. Employees or workers also encounter obstacles in obtaining formal education, as they lack the time to enhance their skills and qualifications to advance up the career ladder. M-learning can address these challenges and foster intellectual and professional development among individuals (Shuja et al., 2019).In a growing context, nations like Pakistan ought to foster an environment where students and teachers utilize mobile devices positively for their learning dedication.

The increasing integration of mobile technology has encouraged educators to fully engage in supporting students and developing new learning approaches for remote learners. Mobile learning methods should be widely adopted in developing countries to enhance educational outcomes. In Pakistan, universities face significant challenges in implementing mobile-assisted learning that includes tutor support and discussion, which leads to a lack of two-way interaction (Butt & Qaisar, 2017). Research by Stone and Logan (2018) found that through mobile learning, students use social media platforms like Facebook to share content and foster discussions. These activities have a significant impact on students' self-assessments and academic performance.

Educators hesitate to pursue and utilize the real advantages of mobile technology that can enhance student learning. To improve students' educational engagement, mobile learning (m-learning) should be integrated with other teaching methods while ensuring supportive communication from teachers. Instructors must take a key role in facilitating interaction, dialogue, and feedback to enhance content comprehension for students (Coll et al., 2014). When learners are motivated to gain knowledge through mobile devices, the instructor's role is crucial in assisting students with understanding the learning material and fostering feedback (Al-Said, 2023). Teachers must engage in implementing the advanced m-learning

pedagogy to deliver live lecture transmissions of classroom instruction, supported by guidance, communication, and oversight for the learners (Khayat & Osama 2022).

M-learning provides convenient access to educational materials, enhancing learning success (Shuja et al., 2019). Mobile learning provides students the opportunity to study in their preferred location, at their speed, and through convenient methods. Learners in less developed countries fail to grasp the possibilities offered by flexible educational methodologies via m-learning (Abduljawad & Ahmad 2023). Portable devices are the least utilized for educational purposes; even part-time students fail to leverage the benefits of using cell phones to achieve a more flexible learning method while managing their jobs (Shak et al., 2022). Students continue to utilize specific classes or learning centers to access online materials but depend more on electronic learning methods and less on mobile devices for flexibility. This process restricts their capacity to utilize adaptive learning flexibility and enhance their educational results. M-learning enables students to choose where, what, and how they learn, thereby efficiently handling the overwhelming influx of information through gained adaptability.

Mobile learning has significantly transformed the delivery of knowledge through digital and virtual education. Previous research has primarily examined the effects of mobile learning on students' technical skills. However, there has been limited focus on how this trend contributes to the development of non-technical or soft skills (Garcia et al., 2015; Bere & Rambe, 2019).

M-learning offers various advantages, such as quick access to educational materials and the development of creative thinking and problem-solving abilities in learners (Mehdipour & Zerehkafi, 2013). Students do not realize the advantages they can achieve by using technology to its fullest extent. One reason for the decline in student performance is that students spend a significant study time on social media applications. Earlier studies examined how M-learning affects students' academic performance and its implications on their learning experiences (Demir & Akpinar, 2018). The suggested model has not been empirically examined in the context of Pakistan before; nonetheless, existing literature offers insights via theoretical frameworks (Luft et al., 2022; Wong et al., 2015). The findings of the study will address the research inquiries regarding whether m-learning improves the academic performance of students in Pakistan.

Research Objectives

a. To assess the academic achievement scores of students using micro-learning through m-learning technology compared to those using conventional teaching methods.

b. To compare the academic achievement scores of students engaged in micro-learning through m-learning technology with those participating in conventional learning methods.

Research Hypotheses

H_1: M-learning technology positively impacts students' academic achievement. Students using M-learning technology will have significantly higher achievement scores than those taught through conventional methods.

H_2: The academic achievement scores of students will significantly improve through the use of M-learning technology.

Review of Literature

Although mobile phone technology has progressed considerably in the last 20 years, it has not kept pace with the advancements in the internet. Despite the vast market for mobile technology, only a small number of effective applications have been developed in the last 20 years. The design of requirements (Hashim et al., 2010), architecture (Luo, 2022), M-learning framework (Crescent & Lee, 2011), and existing trends (Yıldız et al., 2020) represent only a handful of studies focused on the M-learning context that has been carried out. Moreover, numerous tools are offered in the market that enable educators to manage their online assessments and monitor their students' development, such as Cosi et al., (2020). Using mobile technologies, this smart mobile tutoring tool for educators promotes engagement and stimulating discussions. By utilizing web and mobile technology, it allows educators to track and monitor their students' activities effectively. Moreover, it promotes communication between teachers and students via computers or mobile devices using the system. An organizer that is context-aware, named Active Campus, assists with certain classroom activities (Huang et al., 2019).

A new m-learning setting featuring a mobile graph was introduced by (Sarrab et al., 2012) to track the development and performance of students. They state that this system aims to enhance the educational process in Malaysian Schools rather than replace it. Creating and distributing widely accepted standards may require time since the advancement of mobile applications is not yet on par with desktop or personal computer applications (McWherter & Gowell 2012). Consequently, no guidelines have been established for M-learning. Nonetheless, M-learning applications can be developed utilizing the current E-learning standards and frameworks. Advancements in wireless technology have introduced students to mobile learning, or m-Learning, a new educational experience. Experts in this field have proposed various definitions of this type of learning. For example, M-Learning (Korucu & Alkan 2011) refers to e-learning through mobile devices. In 2001, a project group in Norway recognized M-learning as an innovative educational method using mobile devices, driven by geospatial mobility and an increasing preference for flexible learning (Kerski, 2015).

M-Learning is defined by Abduljawad and Ahmad (2023) as education that uses specific technology anytime and anywhere (Abduljawad & Ahmad, 2023). A new definition in 2022 describes it as a learning process that can occur anytime and anywhere convenient for the user (Zhang, 2022). The phrase mobile learning describes a modern approach to education that utilizes mobile networks and devices, broadens the digital learning avenue, and enables individuals to access educational resources, information, and services from any location at any moment (Abduljawad & Ahmad 2023). Mobile applications are context-sensitive because they are personalized devices that continually assess their surroundings, including location, device, and time awareness (Dehlinger & Dixon, 2011). Placing proximity, time, weather, location, etc., into context within m-learning apps enables the provision of dynamic, highly specialized, rich content to learners via context-aware applications. A significant factor contributing to the expansion of M-learning applications is the incorporation of context awareness in M-learning.

In recent years, the internet has grown with the introduction of high-speed mobile devices (Nedashkivskiy et al., 2018). Clark and Mayer (2023) identified five primary types

of online media formats: audio, text, static graphic, video, and animation; however, the choice of media types depends on the requirements or feasibility for both the instructor and the learner (Barut & Dursun 2022). With the increasing technological trend, higher education institutions have also adopted e-learning, thereby sidelining the conventional methods of teaching and learning (Islam et al., 2015). Since that time, there emerged a combination of computer-assisted teaching with media setups to enhance learning and improve students' academic success (Özbek, 2014). Online education is strongly linked to blended learning (Park & Shea 2020), resulting in a growing tendency towards m-learning. Despite a strong tendency to utilize Internet technology, there remains a significant gap between the rise of technological advancement and the acquisition of knowledge from Internet-capable devices. This gap arises from the lack of broadcasted learning; however, it serves as a significant motivation for researchers to clarify the subject (Sanusi & Onijamowo 2023). Milošević et al., (2015) recommended exploring m-learning and its effects on students' performance in relation to reaching educational objectives.

Theoretical Foundation

The conceptual model based on the theoretical framework incorporates backing from "Media Richness Theory" (Elwood et al., 2014), a notion established by Daft and Lengel (1986). The model derives its support from the Media Richness Theory (MRT) Ehondor, (2024) emphasizing that mobile technologies significantly enhance students' learning and improve communication among those involved in interactions (Bernacki, 2020). MRT promotes the utilization of media technology for communication, sharing knowledge, and acquiring knowledge. It indicates that the degree of information sharing and interaction improves when the medium is tailored to meet the educational needs of students (Thoms & Eryilmaz 2014). M-learning, a branch of e-learning, offers convenience regarding mobility, flexibility, and collaboration in sharing knowledge (Razzaque, 2020). It provides enhanced possibilities for student-focused learning and ongoing feedback (Glowa & Goodell 2016). MRT highlights that mobile media differ in their capacities to provide knowledge content. The effectiveness of media largely relies on the characteristics of the communication channel, which include access to personalized information, language diversity, prompt feedback, and timely interactions (Reyna et al., 2018). The level of media richness also facilitates the delivery of broadcast learning to students, ensuring optimal understanding and clarity of the content (Naz & Akbar 2008). Conversely, the less rich the media is, the greater the ambiguity and difficulty in comprehension for the learner.

Mobile learning (M-learning) promotes a dialogue that helps students perform better than before. By using online tools, educators can actively facilitate the development of students' cognitive skills and encourage meaningful communication between teachers and learners (Vlachopoulos & Makri, 2019). In a comparable context, MRT also pertains to ensuring the emergence of flexibility via m-learning, allowing students to acquire knowledge anytime and anywhere, which leads to academic enhancements (Meng, 2021). Groen et al. (2018) examined the results of flexibility and discovered that employees working via telecommuting can achieve their objectives. The cause and effect correlations are established within the understanding of Media Richness Theory, meaning that the more mobile technology is utilized for personalized learning, the higher the likelihood of students excelling alongside top peers, while flexibility and facilitation discussions act as influencing factors throughout the process (Ishii et al., 2019).

Mobile Learning

Mobile learning is the use of mobile devices in education. It can be regarded as a type of e-learning since instructional materials are provided to students online, and educational activities occur via the Internet (Ayu, 2020). Nonetheless, the progress in mobile technologies has enhanced mobile devices' speed and power, establishing them as the preferred option over desktops and laptops for accessing educational content online. Additionally, studies have indicated that mobile devices can facilitate efficient learning in and out of the classroom. Foti and Mendez (2014) state that learners can utilize mobile devices to gather information and engage with others. The benefits of mobile learning are associated with the technological features of mobile devices, such as portability, immediacy, connectivity, ubiquity, and adaptability (Santoianni et al., 2022). Additionally, mobile learning provides access to educational materials at any time and place, making it one of the most impactful innovations in education (Abduljawad & Ahmad 2023).

Micro-Learning

Although a definitive definition for micro-learning in academia does not exist, numerous researchers have examined its theoretical foundation and practical applications within the literature. Drakidou characterizes micro-learning as a novel educational approach that relies on micro-content and micro-media within the contemporary media ecosystem (Drakidou 2018). Alias and Razak argue that the benefits of micro-learning stem from breaking down content and the progression of ICT, allowing learning to happen without limitations of time and location (Alias & Razak 2025). Micro-learning involves a brief segment of knowledge that makes up a learning module, which can be effortlessly obtained, stored, organized, and shared via mobile devices. As intricate knowledge is divided into separate learning modules, it aids understanding and offers learners a convenient, tailored, and enjoyable educational experience (Gera et al., 2022). Micro-learning can be viewed as a modular and segmented learning method; it differs from conventional classroom teaching as it is not confined to specific times, locations, content types, and instructional circumstances. A large number of learners can access it, meeting the growing demand for studying anytime and anywhere in today's world.

Micro-Learning Mode Enabled by WhatsApp

This research applied the micro-learning approach in an undergraduate course titled Theories of Teaching and Learning based on Media Richness Theory. The educational material focuses on motivation in teach (Monib et al., 2024). The course instructor creates the learning materials, primarily videos, audio recordings, images, and written content (Kristanto & Mariano 2017). As illustrated in Fig. 1, the introductory video lasts approximately 5 minutes, showcasing the course instructor outlining the learning goals and expectations for the modular subject. Furthermore, the teacher frequently utilized the audio recordings to clarify the text material and provide examples that would assist students in grasping the essential concepts and theories. The visuals and graphs were employed to convey information in a clearer and more structured manner, aiding students in memorization and understanding. Text content remains the most prevalent instructional format in micro-learning since it facilitates quicker information processing and demands minimal bandwidth for transmission. The instructor subsequently combined these materials into WhatsApp messages and transmitted them to the mobile phones of each student through

the WhatsApp public platform (Guo & Wang 2018). By doing this, students engaged in micro-learning can better manage their educational experience since they can select when, where, and what to learn, and leisurely explore the learning materials based on their preferences.

Figure 1. The Instructional Content

Research Methodology

The main aim of this study is to gather measurable data from a representative group of students, enabling the extrapolation of results to a broader population. By utilizing achievement test questionnaire tools, the research seeks to gather insights on students' experiences, usage frequency, attitudes towards mobile learning technologies, and related academic performance metrics (Lebedeva et al., 2023).

Population of the Study

The participants of this research included all graduate students registered at Fatima Jinnah Women's University in Rawalpindi. This group was selected due to its significance and availability, as graduate students engage in various learning methods, including the use of digital and mobile technologies for their educational tasks. The growing integration of M-learning systems and resources in higher education indicates that graduate students are a vital group for evaluating the effectiveness and influence of these technologies on academic success (Al-Rahmi et al., 2022). These students are believed to have significant experience with mobile learning apps, whether via official institutional platforms or independent learning methods. By concentrating on the entire population of graduate students, the research seeks to guarantee thorough representation to encompass a diverse array of experiences, learning habits, and performance results associated with M-learning. This method improved the representativeness and generalizability of the results within the university, thus aiding in a more profound comprehension of the role that M-learning technology has in the academic advancement of graduate students.

Sample and Sampling

A group of 60 graduate students from Fatima Jinnah Women University, Rawalpindi participated in this research study. All students were of the same age group and gender (female). The sample included individuals who actively utilized mobile learning (M-learning) technology in their education. These students were identified for their consistent use of mobile devices and applications for various educational activities, such as accessing digital course materials, engaging in online discussions, completing assignments, and using educational apps and platforms (Demir & Akpinar, 2018).

The purposive sampling method was employed to ensure that the selected participants were aligned with the study's objectives. This study aims to obtain accurate and meaningful insights into the relationship between mobile technology usage and academic success among graduate students, specifically focusing on active users of mobile learning (M-learning) (Yasan, 2018).

Instruments

The primary research tool used in this study was a questionnaire on accomplishment tests. The test was created by three professional educators to evaluate students' outcomes in learning motivation, social interaction, and cognitive development. The test had a maximum score of 100 and included 40% objective questions, 40% subjective questions, and 20% true/false items. It was designed to evaluate students' memory and comprehension through objective questions, while subjective questions focused on exploring students' motivation for learning, social interaction, and cognitive development. The survey consisted of 50 questions in total, featuring 5 five-point Likert scale items (Kahn & Dempsey 2012).

Validity

The research validated its content by developing assessment tools and teaching resources that aligned with the learning goals and curriculum standards of the course (Tekir & Akar 2019). Expert evaluations were performed with subject-matter experts and educational technologists to ensure that test items effectively assessed the desired learning outcomes. Moreover, construct validity was shown by evaluating academic success across various dimensions—knowledge gain, cognitive growth, motivation, and social interaction—each distinctly outlined and based on recognized theoretical models associated with mobile learning and educational psychology (York et al., 2015).

Reliability

The reliability of the tools was assessed using internal consistency methods. The achievement tests given to both the experimental (micro-learning) and control (traditional) groups showed satisfactory levels of reliability (Almalki, 2021). A Cronbach’s alpha coefficient was calculated for each test section, producing values exceeding the commonly accepted threshold of 0.70, signifying good reliability (Izah et al., 2023). In addition, uniform administration protocols and consistent teaching conditions were upheld across all groups to minimize variability and guarantee test-retest reliability (Bai et al., 2021).

Experimental Procedure

The participants were randomly divided into two groups, each containing 30 students. The micro-learning group and the traditional learning group were presented with identical instructional material, with the sole distinction being the mode of teaching (Díaz et al., 2021). The micro-learning group utilized the micro-learning technology approach to instruction through the mobile application, while the conventional learning group experienced traditional classroom teaching. Both groups completed the test and filled out the questionnaire following the two-week instruction (Adib-Hajbaghery & Karimi 2018).

Data Analysis Procedure and Results

To evaluate the impact of m-learning technology on students' educational performance and learning perspectives. Mean values, standard deviations, and t-values were computed and displayed in the tables. Mean scores and Independent sample t-tests at a .05

significance level were utilized to determine if a notable difference exists in the academic performance of two groups instructed through micro-learning versus conventional learning methods. The hypothesis tests were performed as planned.

Table 1: Post-test scores of both groups regarding learning outcome and comprehension

Achievement test	N	Mean	S.D	df	t-value	Significance /p-value
Micro-learning group	30	42.50	9.020	58	7.766	P < .001
Conventional learning group	30	26.50	6.781			

Table value of "t" at 0.05 = 2.00

Table 1 indicates that the average score for the micro-learning group is 42.50 with a standard deviation of 9.020, while the average score for the conventional learning group is 26.50 with a standard deviation of 6.781. The calculated t-value for df 58 is 7.766. Since the calculated t-value exceeds the table value, it supports hypothesis 1 that m-learning technology positively influences students' academic achievement. It is accepted that the achievement scores will be considerably greater than those of students instructed using traditional teaching methods. Consequently, it can be concluded that the outcomes of both groups vary in the post-tests. The student can improve academic results by utilizing m-learning technology instead of traditional learning methods concerning learning outcomes and understanding elements.

Table 2: Comparison of post-test scores of both groups in the domain of learning motivation aspects.

Achievement test	N	Mean	S.D	df	t-value	Significance /p-value
Micro-learning group	30	13.13	3.002	58	7.724	P < .001
Conventional learning group	30	7.83	2.260			

Table value of "t" at 0.05 = 2.00

Table 2 shows that the average score of the micro-learning group's post-test is 13.13, with a standard deviation of 3.002, while the average score of the conventional learning group's post-test is 7.83, with a standard deviation of 2.260. The calculated t-value for df 58 is 7.724. Since the calculated t-value exceeds the necessary table value. Consequently, hypothesis 2 posits that the academic achievement scores of students will significantly improve due to M-learning technology. It can be concluded that the outcomes of the two groups varied in the post-tests. A notable gap exists between the achievement scores of the micro-learning group and the traditional learning group. It can be inferred that m-learning technology has a beneficial impact on students' academic performance. The student can improve their academic outcomes through m-learning technology instead of traditional methods concerning learning motivation factors.

Table 3: Comparison of post-test scores of both groups in the domain of social interaction aspects.

Achievement test	N	Mean	S.D	df	t-value	Significance /p-value
Micro-learning group	30	14.16	3.006	58	7.766	P < .001
Conventional learning group	30	8.83	2.260			

Table value of "t" at 0.05 = 2.00

Table 3 indicates that the average score of the micro-learning group's post-test is 14.16, with a standard deviation of 3.006, while the average score for the conventional learning group's post-test is 8.83, with a standard deviation of 2.260. The calculated t-value for df 58 is 7.766. Since the calculated t-value exceeds the necessary table value. Consequently, it can be concluded that the outcomes of both groups vary in the post-tests. A notable disparity exists in the achievement scores between the micro-learning group and the traditional learning group. Therefore, it can be inferred that m-learning technology positively influences students' academic performance. The student can improve their academic success through m-learning technology instead of traditional methods related to social interaction components.

Table 4: Comparison of post-test scores of both groups in the domain of cognitive development aspects.

Achievement test	N	Mean	S.D	df	t-value	Significance /p-value
Micro-learning group	30	15.20	3.021	58	7.789	P < .001
Conventional learning group	30	9.83	2.260			

Table value of "t" at 0.05 = 2.00

Table 4 shows that the average score of the micro-learning group's post-test is 15.20 with a standard deviation of 3.021, while the average score of the post-test for the conventional learning group is 9.83 with a standard deviation of 2.260. The calculated t-value for df 58 is 7.789. Since the calculated t-value exceeds the necessary table value. The average disparity between the two groups shows that the micro-learning group outperforms the conventional learning group. Based on the average scores, it can be determined that the outcomes of both groups vary in the post-tests. It can be stated that m-learning technology positively influences students' academic performance. The learner can enhance their academic results by utilizing m-learning technology rather than traditional approaches, especially in cognitive growth.

Research shows that using micro-learning positively impacts students' motivation, social interaction, and cognitive development compared to traditional learning methods. As a result, m-learning technology significantly enhances students' academic achievement. Overall, the m-learning approach is more effective than traditional teaching methods.

Discussion

The integration of mobile learning (m-learning) technologies into higher education has garnered considerable interest due to its potential to transform traditional pedagogical

approaches and improve academic outcomes. The findings from the present study offer empirical evidence in support of m-learning as a powerful educational tool, as demonstrated by statistically significant differences in academic performance between students exposed to micro-learning via mobile technology and those instructed through conventional methods.

Enhanced Academic Performance

Table 1 reveals that students engaged in micro-learning achieved a higher mean score (M = 42.50, SD = 9.020) compared to their peers in conventional learning (M = 26.50, SD = 6.781), with a t-value of 7.766 (df = 58), which is statistically significant. It supports Hypothesis 1 that m-learning positively affects academic achievement. These results align with prior research indicating that m-learning offers a flexible, interactive, and student-centered learning environment that enhances knowledge retention and comprehension (Alrasheedi et al., 2015; Crompton & Burke, 2018). Moreover, micro-learning, which involves delivering content in small, manageable units, is conducive to mobile platforms, promoting consistent engagement and reducing cognitive overload (Ifenthaler & Schweinbenz, 2013). This pedagogical strategy appears especially effective in higher education settings where students often balance multiple responsibilities.

Improvement in Test Scores

Table 2 further substantiates the efficacy of m-learning, with students in the micro-learning group scoring significantly higher on achievement tests (M = 13.13, SD = 3.002) than those in the conventional group (M = 7.83, SD = 2.260), with a t-value of 7.724. It supports Hypothesis 2 and illustrates a substantial impact of m-learning on immediate academic performance. Recent studies confirm this trend. According to Sung, Chang, and Liu (2016), students using mobile technologies showed improved test scores and a better understanding of subject matter across various disciplines. The ability of m-learning to provide real-time feedback, customized content, and access to multimedia resources enhances cognitive processes and fosters academic success (Kearney et al., 2012).

Post-Test Achievement and Social Learning Aspects

Table 3 shows the test scores of students in the micro-learning group (M = 14.16, SD = 3.006) were markedly higher than those in the conventional group (M = 8.83, SD = 2.260), with a t-value of 7.766. It indicates that not only does m-learning lead to immediate learning gains, but it also supports knowledge retention and application over time. These results emphasize the positive effects of m-learning on long-term academic achievement. Furthermore, m-learning facilitates increased social interaction and collaborative learning, specifically through features such as discussion forums, peer messaging, and mobile-accessible group projects (Baran, 2014). The enhanced social dimension of learning is a critical factor in student motivation and engagement, which, in turn, contributes to improved academic performance.

Cognitive Development and Learning Motivation

Table 4 highlights the influence of m-learning on cognitive development, with a mean score of 15.20 (SD = 3.021) for the micro-learning group compared to 9.83 (SD = 2.260) for the conventional group (t = 7.789). These findings highlight the cognitive advantages of m-learning tools, especially in fostering higher-order thinking skills like analysis, evaluation, and synthesis. According to Traxler (2018), mobile learning environments foster

metacognition and autonomy, essential components of cognitive development in university students. The constant accessibility of learning materials allows students to engage with content at their own pace and according to their preferred learning styles, thereby enhancing both intrinsic motivation and academic outcomes (Chen et al., 2015).

Conclusion

The findings of this study provide strong empirical support for the positive impact of mobile learning (m-learning) technology on the academic achievement of university students. Across multiple dimensions—including overall test performance, post-test retention, learning motivation, cognitive development, and social interaction—students exposed to micro-learning via mobile platforms consistently outperformed their peers taught through conventional instructional methods.

The statistical analyses revealed significant differences in mean scores between the two groups, with consistently higher achievement observed among the m-learning participants. These results affirm that mobile learning technologies not only enhance immediate academic performance but also foster deeper cognitive engagement and promote learner autonomy and motivation. The interactive and flexible nature of m-learning environments appears to align well with the learning preferences of contemporary university students, contributing to more effective knowledge acquisition and skill development.

Particularly with these outcomes, it is recommended that higher education institutions actively integrate m-learning strategies into their curricula. Doing so will not only modernize instructional approaches but also enhance student engagement and learning outcomes. Additionally, educators must have the requisite training and technological proficiency to leverage mobile learning tools effectively. As digital learning continues to evolve, m-learning stands out as a transformative approach with the potential to redefine educational delivery and support student success in diverse academic settings.

Impact and Implications

The findings demonstrate that students exposed to m-learning technologies outperform their counterparts in conventional settings in terms of academic performance, cognitive development, learning motivation, and social interaction. The significant differences observed in all measured variables provide robust support for incorporating mobile learning into higher education curricula.

Implications

Curriculum Development: Universities should consider embedding m-learning strategies into their teaching models to foster a more interactive and personalized learning experience.

Faculty Training: Educators need training to effectively design and deliver content utilizing mobile technologies.

Student Support Services: Institutions should ensure equitable access to mobile learning tools and resources.

Recommendations for Future Researchers

This research contributes to the growing literature supporting innovative digital pedagogies in higher education. Future studies should investigate the long-term effects of mobile learning on academic achievement and assess its impact across various disciplines and educational contexts.

References

Abachi, H. R., & Muhammad, G. (2014). The impact of m-learning technology on students and educators. *Computers in human behavior*, *30*, 491-496.

Abdekhoda, M., Pourrasmi, A., & Ranjbaran, F. (2023). The effect of knowledge acquisition and knowledge sharing on the use of E-learning. *Journal of Information Science*, 01655515221142429.

Abduljawad, M., & Ahmad, A. (2023). An analysis of mobile learning (M-Learning) in education. *Multicultural Education*, *9*(2), 145-152.

Adib-Hajbaghery, M., & Karimi, Z. (2018). Comparing the effects of face-to-face and video-based education on inhaler use: A randomized, two-group pretest/posttest study. *Iranian journal of nursing and midwifery research*, *23*(5), 352-357.

Aguilar-Santelises, L., Corona-Ortega, M. T., Cruz-Millán, M., Rojas-Fernández, A. G., Aguilar-Santelises, M., & García-del Valle, A. (2015). Keeping Teachers Up-to-date is essential to reach and maintain a High Quality University Education. *Multidisciplinary Journal for Education, Social and Technological Sciences*, *2*(1), 1-14.

Ahmad, E. A. (2024). Revolutionizing learning: leveraging social media platforms for empowering open educational resources. *International Journal of e-Learning and Higher Education (IJELHE)*, *19*(1), 83-106.

Ahmad, I., Said, H., Hussain, A., & Khan, S. (2014). BARRIERS TO CO-EDUCATION IN PAKISTAN AND ITS IMPLICATIONS ON GIRLS EDUCATION: CRITICAL REVIEW OF LITERATURE. *Science International*, *26*(1).

Alam, Z. F. (2016). The assessment of the e-waste management generated from cellular phones, laptops, and personal computers in the Philippines. *Manila Journal of Science*, *9*(2016), 27-42.

Alias, N. F., & Razak, R. A. (2025). Revolutionizing learning in the digital age: A systematic literature review of micro learning strategies. *Interactive Learning Environments*, *33*(1), 1-21.

Ally, M., Grimus, M., & Ebner, M. (2014). Preparing teachers for a mobile world, to improve access to education. *Prospects*, *44*(1), 43-59.

Almalki, M. E. M. (2021). Designing a Micro-Learning-Based Learning Environment and Its Impact on Website Designing Skills and Achievement Motivation Among Secondary School Students. *International Journal of Computer Science & Network Security*, *21*(12), 335-343.

Al-Rahmi, A. M., Al-Rahmi, W. M., Alturki, U., Aldraiweesh, A., Almutairy, S., & Al-Adwan, A. S. (2022). Acceptance of mobile technologies and M-learning by university students: An empirical investigation in higher education. *Education and Information Technologies*, *27*(6), 7805-7826.

Alrasheedi, M., Capretz, L. F., & Raza, A. (2015). A systematic review of the critical factors for success of mobile learning in higher education (university students' perspective). *Journal of Educational Computing Research*, *52*(2), 257-276.

Al-Said, K. (2023). Influence of teacher on student motivation: Opportunities to increase motivational factors during mobile learning. *Education and Information Technologies*, *28*(10), 13439-13457.

Ayu, M. (2020). Online learning: Leading e-learning at higher education. *The Journal of English Literacy Education: The Teaching and Learning of English as a Foreign Language*, *7*(1), 47-54.

Bai, W., Al-Karaghouli, M., Stach, J., Sung, S., Matheson, G. J., & Abraldes, J. G. (2021). Test–retest reliability and consistency of HVPG and impact on trial design: a study in 289 patients from 20 randomized controlled trials. *Hepatology*, *74*(6), 3301-3315.

Baran, E. (2014). A review of research on mobile learning in teacher education. *Journal of Educational Technology & Society*, *17*(4), 17-32.

Barut Tugtekin, E., & Dursun, O. O. (2022). Effect of animated and interactive video variations on learners' motivation in distance Education. *Education and Information Technologies*, *27*(3), 3247-3276.

Bere, A., & Rambe, P. (2019). Understanding mobile learning using a social embeddedness approach: A case of instant messaging. *International Journal of Education and Development using Information and Communication Technology*, *15*(2), 132-153.

Bergin, R. I. C. H. A. R. D. (2016). Media richness theory. *Center for Homeland Defense and Security*.

Bernacki, M. L., Greene, J. A., & Crompton, H. (2020). Mobile technology, learning, and achievement: Advances in understanding and measuring the role of mobile technology in education. *Contemporary Educational Psychology*, *60*, 101827.

Bombaes, A. (2018). Student's intentions to use m-learning: An empirical perspective from the Philippines. *Learning*, *8*(1).

Brown, T. H., & Mbati, L. S. (2015). Mobile learning: Moving past the myths and embracing the opportunities. *International Review of Research in Open and Distributed Learning*, *16*(2), 115-135.

Butt, I. H., & Qaisar, S. (2017). Readiness of Pakistani University Teachers and Students for M-Learning in a Public University. *Journal of Research & Reflections in Education (JRRE)*, *11*(1).

Cassidy, E. D., Colmenares, A., Jones, G., Manolovitz, T., Shen, L., & Vieira, S. (2014). Higher education and emerging technologies: Shifting trends in student usage. *The Journal of Academic Librarianship*, *40*(2), 124-133.

Chen, B., Seilhamer, R., Bennett, L., & Bauer, S. (2015). Students' mobile learning practices in higher education: A multi-year study. *Edu cause review*, *7*(3), 225-235.

Clark, R. C., & Mayer, R. E. (2023). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. John Wiley & sons.

Coll, C., Rochera, M. J., & De Gispert, I. (2014). Supporting online collaborative learning in small groups: Teacher feedback on learning content, academic task and social participation. *Computers & Education*, *75*, 53-64.

Cosi, A., Voltas, N., Lázaro-Cantabrana, J. L., Morales, P., Calvo, M., Molina, S., & Quiroga, M. Á. (2020). Formative assessment at university through digital technology tools. *Profesorado, revista de currículum y formación del profesorado*, *24*(1), 164-183.

Crescente, M. L., & Lee, D. (2011). Critical issues of m-learning: design models, adoption processes, and future trends. *Journal of the Chinese institute of industrial engineers*, *28*(2), 111-123.

Crompton, H., & Burke, D. (2018). The use of mobile learning in higher education: A systematic review. *Computers & education*, *123*, 53-64.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management science*, 32(5), 554-571.

Dehlinger, J., & Dixon, J. (2011, October). Mobile application software engineering: Challenges and research directions. In *Workshop on mobile software engineering* (Vol. 2, pp. 29-32).

Demir, K., & Akpinar, E. (2018). The Effect of Mobile Learning Applications on Students' Academic Achievement and Attitudes toward Mobile Learning. *Malaysian Online Journal of Educational Technology*, *6*(2), 48-59.

Dey, B. L., Babu, M. M., Rahman, M., Dora, M., & Mishra, N. (2019). Technology upgrading through co-creation of value in developing societies: Analysis of the mobile telephone industry in Bangladesh. *Technological Forecasting and Social Change*, *145*, 413-425.

Díaz Redondo, R. P., Caeiro Rodríguez, M., López Escobar, J. J., & Fernández Vilas, A. (2021). Integrating micro-learning content in traditional e-learning platforms. *Multimedia Tools and Applications*, *80*(2), 3121-3151.

Drakidou, C. (2018). Micro-learning as an Alternative in Lifelong eLearning. *The Aristotle University of Thessaloniki*.

Ehondor, B. A. (2024). The 5-M Downsizing Communication Model for Survivor-Employee Engagement. *Journal of Organizational Psychology*, *24*(3).

Elwood, S., McCaleb, K., Fernandez, M., & Keengwe, J. (2014). A theoretical framework and model towards media-rich social presence design practices. *Education and Information Technologies*, *19*, 239-249.

Feng, Y., Liao, Y., & Ren, Y. (2018). Effects of m-learning on students' learning outcome: a meta-analysis. In *New media for educational change: Selected papers from HKAECT 2018 international conference* (pp. 115-123). Springer Singapore.

Foti, M. K., & Mendez, J. (2014). Mobile learning: How students use mobile devices to support learning. *Journal of Literacy and Technology*, *15*(3), 58-78.

Garcia-Cabot, A., de-Marcos, L., & Garcia-Lopez, E. (2015). An empirical study on m-learning adaptation: Learning performance and learning contexts. *Computers & Education*, *82*, 450-459.

Gera, R., Bartolf, D. M., Tick, S., & Saxena, A. (2022). CHUNK Learning: A Tool that Supports Personalized Education. In *Proceedings of the 15th International Conference on Educational Data Mining* (p. 743).

Glowa, L., & Goodell, J. (2016). Student-Centered Learning: Functional Requirements for Integrated Systems to Optimize Learning. *International Association for K-12 Online Learning*.

Groen, B. A., Van Triest, S. P., Coers, M., & Wtenweerde, N. (2018). Managing flexible work arrangements: Teleworking and output controls. *European Management Journal*, *36*(6), 727-735.

Guo, M., & Wang, M. (2018). Integrating WeChat-based mobile-assisted language learning into college English teaching. *EAI Endorsed Transactions on E-Learning*, *5*(17).

Hashim, A. S., Ahmad, W. F. W., & Rohiza, A. (2010, December). A study of design principles and requirements for the m-learning application development. In *2010 International Conference on User Science and Engineering (i-USEr)* (pp. 226-231). IEEE.

Huang, L. S., Su, J. Y., & Pao, T. L. (2019). A context aware smart classroom architecture for smart campuses. *Applied sciences*, *9*(9), 1837.

Ifenthaler, D., & Schweinbenz, V. (2013). The acceptance of Tablet-PCs in classroom instruction: The teachers' perspectives. *Computers in human behavior*, *29*(3), 525-534.

Imgraben, J., Engelbrecht, A., & Choo, K. K. R. (2014). Always connected, but are smart mobile users getting more security savvy? A survey of smart mobile device users. *Behaviour & Information Technology*, *33*(12), 1347-1360.

Ishii, K., Lyons, M. M., & Carr, S. A. (2019). Revisiting media richness theory for today and future. *Human behavior and emerging technologies*, *1*(2), 124-131.

Islam, N., Beer, M., & Slack, F. (2015). E-learning challenges faced by academics in higher education. *Journal of Education and Training Studies*, *3*(5), 102-112.

Izah, S. C., Sylva, L., & Hait, M. (2023). Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment. *ES Energy & Environment*, *23*, 1057.

Kahn, K., & Dempsey, J. (2012). An investigation of centers for innovation. *International Journal of Innovation Science*, *4*(2), 89-100.

Kanwal, F., & Rehman, M. (2017). Factors affecting e-learning adoption in developing countries–empirical evidence from Pakistan's higher education sector. *Ieee Access*, *5*, 10968-10978.

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Alt-J-Research In Learning Technology*, *20*(1).

Keengwe, J., & Bhargava, M. (2014). Mobile learning and integration of mobile technologies in education. *Education and Information Technologies*, *19*, 737-746.

Kerski, J. J. (2015). Opportunities and challenges in using geospatial technologies for education. *Geospatial technologies and geography education in a changing world: Geospatial practices and lessons learned*, 183-194.

Khayat, D., & Osama, S. (2022). *The Impact of using flipped mobile learning in continuing professional development to develop electronic lecture skills among female university teachers in the kingdom of Saudi Arabia* (Doctoral dissertation, University of Southampton).

Klimova, B. (2019). Impact of mobile learning on students' achievement results. *Education Sciences*, *9*(2), 90.

Korucu, A. T., & Alkan, A. (2011). Differences between m-learning (mobile learning) and e-learning, basic terminology and usage of m-learning in education. *Procedia-Social and Behavioral Sciences*, *15*, 1925-1930.

Kristanto, A., & Mariono, A. (2017). The Development of Instructional Materials E-Learning Based on Blended Learning. *International Education Studies*, *10*(7), 10-17.

Kroski, E. (2008). On the move with the mobile web: libraries and mobile technologies. *Library technology reports*, *44*(5), 1-48.

Lebedeva, Marina, Marina Taranova, and Vladimir Beketov. "Assessment of academic achievements in m-learning." *Education and Information Technologies* 28.5 (2023): 5945-5965.

Lindsay, L. (2016). Transformation of teacher practice using mobile technology with one-to-one classes: M-learning pedagogical approaches. *British Journal of Educational Technology*, *47*(5), 883-892.

Luft, J. A., Jeong, S., Idsardi, R., & Gardner, G. (2022). Literature reviews, theoretical frameworks, and conceptual frameworks: An introduction for new biology education researchers. *CBE—Life Sciences Education*, *21*(3), rm33.

Luo, Y. (2022). Analysis of Mobile Learning Model and Design of Mobile English Platform Based on Service-Oriented Architecture. *Mobile Information Systems*, *2022*(1), 3612420.

Martin, F., & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education*, *68*, 76-85.

McWherter, J., & Gowell, S. (2012). *Professional mobile application development*. John Wiley & Sons.

Mehdipour, Y., & Zerehkafi, H. (2013). Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research*, *3*(6), 93-101.

Meng, M. W. (2021). Empirical research on mobile learning diffusion factor based on MRT theory and internet interaction characteristics: A case study of students in china's

higher education institutions. *EMPIRICAL RESEARCH ON MOBILE LEARNING DIFFUSION FACTOR BASED ON MRT THEORY AND INTERNET INTERACTION CHARACTERISTICS: A CASE STUDY OF STUDENTS IN CHINA'S HIGHER EDUCATION INSTITUTIONS*.

Merchant, G. (2012). Mobile practices in everyday life: Popular digital technologies and schooling revisited. *British journal of educational technology*, *43*(5), 770-782.

Milošević, I., Živković, D., Manasijević, D., & Nikolić, D. (2015). The effects of the intended behavior of students in the use of M-learning. *Computers in Human Behavior*, *51*, 207-215.

Mishra, A. K., & Aithal, P. S. (2022). Analysis of Laptop Users Purchase Behaviour: A Case of Kathmandu, Nepal. *Operational Analysis of Projects in Nepal*.

Monib, W. K., Qazi, A., Apong, R. A., & Mahmud, M. M. (2024). Investigating learners' perceptions of micro learning: Factors influencing learning outcomes. *IEEE Access*.

Naz, A. A., & Akbar, R. A. (2008). Use of media for effective instruction its importance: some consideration. *Journal of elementary education*, *18*(1-2), 35-40.

Nedashkivskiy, O., Semenko, A., Kozlov, A., & Bokla, N. (2018). Internet: models, technologies, access speed, prospects.

Nikolopoulou, K. (2022). Students' mobile phone practices for academic purposes: strengthening post-pandemic university digitalization. *Sustainability*, *14*(22), 14958.

Obiadazie, R. E., & Obijiofor, V. U. (2015). Use of mobile phone technology in education for easy accessibility of information: challenges and prospects. *AFRREV IJAH: An International Journal of Arts and Humanities*, *4*(2), 164-178.

Özbek, G. (2014). *The development of a model for tablet pc usage in education: Expectations to realities* (Doctoral dissertation, Middle East Technical University (Turkey).

Pakistan Telecommunication Authority (PTA). (2017). Telecom indicators. Retrieved form http://www.pta.gov.pk/index.php?option=com_content&task=view&id=269&Itemid = 658

Park, H., & Shea, P. (2020). A Review of Ten-Year Research through Co-citation Analysis: Online Learning, Distance Learning, and Blended Learning. *Online Learning*, *24*(2), 225-244.

Pimmer, C., Mateescu, M., & Gröhbiel, U. (2016). Mobile and ubiquitous learning in higher education settings. A systematic review of empirical studies. *Computers in human behavior*, *63*, 490-501.

Razzaque, A. (2020). M-learning improves knowledge sharing over e-learning platforms to build higher education students' social capital. *Sage Open*, *10*(2), 2158244020926575.

Reyna, J., Hanham, J., & Meier, P. (2018). The Internet explosion, digital media principles and implications to communicate effectively in the digital space. *E-learning and Digital Media*, *15*(1), 36-52.

Roco, M. C., & Bainbridge, W. S. (2013). The new world of discovery, invention, and innovation: convergence of knowledge, technology, and society. *Journal of nanoparticle research*, *15*, 1-17.

Sanakulov, N., & Karjaluoto, H. (2017). A cultural comparison study of smartphone adoption in Uzbekistan, South Korea and Turkey. *International Journal of Mobile Communications*, *15*(1), 85-103.

Santoianni, F., Petrucco, C., Ciasullo, A., & Agostini, D. (2022). *Teaching and mobile learning: Interactive educational design*. CRC Press.

Sanusi, B. O., & Onijamowo, R. O. (2023). THE ROLE OF EDUCATIONAL BROADCASTING IN BRIDGING LEARNING GAPS. *SAPIENTIA FOUNDATION JOURNAL OF EDUCATION, SCIENCES AND GENDER STUDIES*, *5*(4).

Sarrab, M., Elgamel, L., & Aldabbas, H. (2012). Mobile learning (m-learning) and educational environments. *International journal of distributed and parallel systems*, *3*(4), 31.

Shaikh, Z. A., Umrani, A. I., Jumani, A. K., & Laghari, A. A. (2019). Technology enhanced learning: a digital timeline learning system for higher educational institutes. *International Journal of Computer Science and Network Security*, *19*(10), 1-5.

Shak, P., Hiew, W., & Tobi, B. (2022). Challenges in technology integration for online teaching and learning for English sessional academics. *Computer-Assisted Language Learning Electronic Journal*, *23*(1), 233-258.

Shuja, A., Qureshi, I. A., Schaeffer, D. M., & Zareen, M. (2019). Effect of M-Learning on Students' Academic Performance Mediated by Facilitation Discourse and Flexibility. *Knowledge Management & E-Learning*, *11*(2), 158-200.

Stone, S., & Logan, A. (2018). Exploring students' use of the social networking site WhatsApp to foster connectedness in the online learning experience. *Irish Journal of Technology Enhanced Learning Ireland*, *3*(1), 42-55.

Subramani, P. N., & Iyappan, V. (2018). Innovative methods of teaching and learning. *Journal of applied and advanced research*, *3*(1), 20.

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. Computers & Education, 94, 252-275.

Tekir, S., & Akar, H. (2019). The current state of instructional materials education: Aligning policy, standards, and teacher education curriculum. *Educational Sciences: Theory and Practice*, *19*.

Thoms, B., & Eryilmaz, E. (2014). How media choice affects learner interactions in distance learning classes. *Computers & Education*, *75*, 112-126.

Traxler, J. M. (2018). Learning with mobiles in developing countries: Technology, language, and literacy. In *Information and technology literacy: Concepts, methodologies, tools, and applications* (pp. 774-790). IGI Global.

Tuksanova, Z., & Nazarov, E. (2020). Effective use of innovative technologies in the education system. *Интернаука*, (16-3), 30-32.

Vanden Abeele, M. M. (2016). Mobile youth culture: A conceptual development. *Mobile Media & Communication*, *4*(1), 85-101.

Vlachopoulos, D., & Makri, A. (2019). Online communication and interaction in distance higher education: A framework study of good practice. *International Review of Education*, *65*(4), 605-632.

Wong, C. Y., Wong, C. W., & Boon-Itt, S. (2015). Integrating environmental management into supply chains: a systematic literature review and theoretical framework. *International Journal of Physical Distribution & Logistics Management*, *45*(1/2), 43-68.

Yasan AK, N. (2018). The investigation of undergraduate students' mobile phone use in the academic environment: The case of Middle East technical university.

Yıldız, G., Yıldırım, A., Akça, B. A., Kök, A., Özer, A., & Karataş, S. (2020). Research trends in mobile learning. *International Review of Research in Open and Distributed Learning*, *21*(3), 175-196.

York, T. T., Gibson, C., & Rankin, S. (2015). Defining and measuring academic success. *Practical assessment, research & evaluation*, *20*(5), n5.

Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The met averse in education: Definition, framework, features, potential applications, challenges, and future research topics. *Frontiers in Psychology*, *13*, 1016300.