Adv Mobile Learn Educ Res, 2023, 3(1): 610-620
DOI: 10.25082/AMLER.2023.01.010

RESEARCH ARTICLE

The use of mobile learning applications in higher education institutes

Juraev Tuychi Norbutayevich

Karshi State University, Karshi, Uzbekistan

Correspondence to: Juraev Tuychi Norbutayevich, Karshi State University, Karshi, Uzbekistan;
Email: jurayevtuychi@gmail.com

Received: November 24, 2022;
Accepted: January 23, 2023;
Published: January 27, 2023.

Citation: Norbutayevich, J. T. (2023). The use of mobile learning applications in higher education institutes. *Advances in Mobile Learning Educational Research*, 3(1), 610-620.
https://doi.org/10.25082/AMLER.2023.01.010

Abstract: Nowadays, many people, especially students, enjoy spending their free time with mobile devices. The main reason for this is that an intelligent device based on current information presents the desires and requirements of students. A nowadays-promising technology to overcome the problems in m-learning, mobile devices provide reliable, customized and guaranteed dynamic computing environments for all users. This article presents a new pedagogical architecture for a mobile learning system in an extended cloud-computing environment enriched with smart devices. This architecture can be applied everywhere where there is a need for intensive teaching and learning in higher education. The system architecture was described together with the discussion of knowledge assessment methods possibilities and potential issues. In addition, a solution to the problem of developing applications for organizing mobile learning using the visual programming environment MIT App Inventor is proposed. The results of experiments on the use of mobile education were analyzed and presented in tabular diagram form.

Keywords: digital learning, M-learning, mobile learning applications, educational technology

1 Introduction

In contrast to the traditional classroom, mobile technologies effectively offer students added convenience and flexibility, allowing them to learn wherever and whenever they choose. In situations where mobile technologies are integrated into a classroom environment, there are opportunities to soften the rigidity of the standard classroom arrangement because each learner is "connected" wherever they choose to be in that learning space (Barianos, Papadakis & Vidakis, 2022). Outside the classroom, learners can continue their studies in spaces that meet their individual needs (Chaldi & Mantzanidou, 2021). Mobile technologies empower learners to participate conveniently in learning environments (Dahal et al., 2022; Shih & Mills, 2007). In higher education, mobile technologies are used in an auditory environment. There are opportunities to soften the rigidity of the standard classroom arrangement because each student wants to use mobile technologies in the education prosses (Drolia et al., 2022).

M-learning has the potential to become an effective solution for providing education along with traditional methods (Kalogiannakis & Papadakis, 2017). Motivating learners about the benefits of using m-learning for higher education is essential (Lavidas et al., 2022). The ease of use and usefulness of m-learning systems can add value to the existing learning management system through advancement in the learning process and enhancing the learner's acceptance of m-learning (Sarrab et al., 2016). For example, in the assessment phase of education, it can be shown that the use of mobile applications is based on the liberalization of assessment value.

The adoption of mobile technologies has generated a profound transformation of the university and has affected processes, operations, and organizational structures by presenting new management concepts (Karakose et al., 2022). Higher education institutions are therefore called to align the functional structures through which they work with a mobile education policy in line with their administrative and operational capacity available and culture (Lazarinis et al., 2022). Beyond the technical difficulties, an even more significant aspect of m-learning adoption lies in identifying how to approach institutional transformation in higher education; the importance of integrating new and more agile tools of communication, information dissemination, and knowledge transmission will only be possible when institutions clarify and understand the organizational landscape that defines them (Gómez-Ramirez et al., 2019; Maharjan et al., 2022). M-learning is the modern technology for the digital age of the XXI century, and this aroused particular interest among students.

2 Literature review

Many types of research on the use of electronic devices (Kibuku et al., 2020), (Adinda & Mohib, 2020), (Clapp, 2017), (Manurung et al., 2022), (Al-Adwan et al., 2018), (Kibuku et al., 2020) and on the use of mobile devices in education (Al-Adwan et al., 2018), (Krull & Duart,

2017), (Okai-Ugbaje, 2021), (Alsswey et al., 2020), (Okai-Ugbaje et al., 2020), (Adinda & Mohib, 2020), (Ristanto et al., 2022), (Sariyatun et al., 2018), (Dewi et al., 2019), (Osman, 2010), (Dahri et al., 2022), (Dahri et al., 2022), (Mayhuay & Cruz, 2023) on the process of learning have been conducted.

2.1 Problems in mobile education and implementation

Mobile learning is proving to be a fertile ground for innovation (Maksum et al., 2022). However, it is essential to realize that the success of mobile learning will depend on human factors in the use of the new mobile and wireless technologies. It is only now that the challenges of mobile learning on a larger scale and with diverse populations of students are beginning to be understood (Kukulska-Hulme, 2007; Papadakis, 2021). However, new modern, intellectually developed mobile learning programs give students knowledge without the human factor, and such programs need to be more robust (Papadakis & Kalogiannakis, 2017). Creating such mobile software tools is highly valued in the software market as it requires much knowledge (Papadakis et al., 2021).

I modify transactional distance theory and adopt it as a relevant theoretical framework for mobile learning in distance education. Furthermore, I position earlier studies into four types of mobile learning: 1) high transactional distance socialized m-learning, 2) high transactional distance individualized m-learning, 3) low transactional distance socialized m- learning, and 4) low transactional distance individualized m-learning. As a result, this paper can be used by instructional designers of open and distance learning to learn about mobile learning concepts and how mobile technologies can be incorporated into their teaching and learning more effectively (Park & Tech, 2011; Karakose, Tülübaş, & Papadakis, 2022).

2.2 Mobile learning facilities

Learners' autonomy is crucial for increasing the intention of the learners to use m-learning (Qureshi & Qureshi, 2021). Therefore, if companies or schools want to develop m-learning apps, they should first concentrate on increasing the learners' autonomy elements such as exams and quizzes. Content quality design positively affected the effort expectancy and performance expectancy of m-learning. Content quality design can be realized by providing students with up-to-date content with multimedia effects such as audio, video, and animation content (Arıcı et al., 2022). Performance expectation has a high impact on the intention to use m-learning. Mobile learning designers must design mobile learning applications that improve students' performance, such as designing faster browsing and downloading applications (Ali & Mohd Arshad, 2018; Papadakis, 2018). As mentioned above, the quality design of mobile applications can be achieved by providing students with contemporary content with multimedia effects such as audio, video, and animation. In addition, the quality of mobile learning applications is assessed by such parameters as a modern knowledge base, the level of interactivity in knowledge control, and the speed of the application.

M-Learning - Mobile application for organizing digital education for students:

(1) To have an identifiable identity in digital education;

(2) Studying subjects online and offline from a smartphone and tablet with text, video, and animation;

(3) Each student of the group must individually answer the questions of the test, crossword, corresponding to the topic of the subject, and pass an online assessment;

(4) Online study of theoretical information, definitions, concepts, and terms corresponding to each topic using an explanatory dictionary;

(5) The ability to exchange information with the teacher and colleagues in the group using chat, forum, and e-mail;

(6) Online assessment of practical and laboratory assignments;

(7) Using a questionnaire, each group member should express their opinion about the pros and cons of the teacher who conducts the lesson.

M-Learning - Mobile application that organizes digital education for a teacher:

(1) Takes control of identity verification in digital education;

(2) Uses interactive methods when conducting online training based on webinars;

(3) Constant online control of students' knowledge;

(4) the ability to exchange information online with colleagues and students using chat, forum, and e-mail;

(5) Updating practical and laboratory assignments, online assessment of the implementation process;

(6) It creates opportunities for updating online theoretical data, definitions and concepts, and a glossary of terms corresponding to each topic (Tuychi, 2022).

Mobile learning offers several advantages over other forms like ubiquity and idle time utilization. However, for these advantages to be adequately addressed, there should be a check on the

system's quality. Inadequate quality systems will invalidate these benefits. Quality estimation in M-learning systems can be broadly classified into software system quality and learning characteristics. In this work, an m-Learning framework is first developed. Software System quality is then evaluated following the ISO/IEC 25010 Software Quality model by proposing a set of metrics that measure the characteristics of an M-Learning system. The applications of these metrics were then illustrated numerically (Acharya & Sinha, 2013). In the era of globalization, mobile applications will need to be adapted to the needs of the education market to develop and implement some international concepts for mobile education applications.

The tremendous and rapid developments in the information and communications technology sector and mobile devices have resulted in modern technologies, one of which is Mobile Learning (M-learning). M-learning is a new learning technique that helps students do their educational activities and access learning materials efficiently without temporal or spatial restrictions with the help of mobile devices. It is a robust part to make learning easy and flexible. Recently, many applications and services related to it have been developed. Despite the substantial number of researchers who have dealt with the topic of M-learning, the issue of factors affecting the adoption of M-learning has yet to be dealt with adequately, especially in Palestine. Therefore, it becomes necessary to explore the factors influencing the intentions of the students of higher education institutions to adopt M-learning (Qashou, 2021).

The findings prove that relative advantage, complexity, social influence, easing conditions, and perceived enjoyment represent key facilitators of m-learning. On the other hand, self-management of learning is considered a key inhibitor in adopting m-learning. This study has practical implications for m-learning providers and developers. M-learning developers should design effortless applications that are compatible with students' needs. Additionally, they should offer applications that are effective compared to earlier learning styles and tools. Students are expected to recognize the benefits of m-learning on their overall learning performance. M-learning providers and educators should encourage and promote the use of m-learning.

Additionally, senior management should make sure that resources and technical support for m-learning are in place whenever needed by students (Al-Adwan et al., 2018). Leadership intervention in education should be from a purely scientific point of view. It is a proven idea that there are better ideas than limiting the student's use of modern technical means in the classroom. Nowadays, students are creating healthy scientific competition to prove that they are sometimes smarter than classroom teachers, which can often lead to better results in the system.

Key findings show that researchers conduct studies on mobile learning in higher education for assorted reasons but that evaluating the effectiveness is the most common purpose. Similarly, various themes within mobile learning are explored, but the most common topic focuses on enabling applications and systems. An increasing number of studies have focused on the use and affordances of smartphones (for example, the use of specific apps) rather than basic phones and features (for example, text messaging). Newer research topics related to mobile learning, social networking, games, and augmented reality. Research methods are split between quantitative and qualitative methods. Data collection continues to focus primarily on surveys, but a wider variety of methods is being utilized (Krull & Duart, 2017). Ensuring students' scientific independence in the classroom and their creative approach to the topic is one of the main challenges of today. Mobile education is an excellent solution to the individualization of education for students.

The question is still what the 'ideal' device and solution for mobile learning will look like. However, the answer will rest with students' individual preferences. That is why the Norwegian Knowledge Institute has found it extremely important to experiment with different solutions, which, in turn, have inspired further developments in finding the right mix of course design and system solutions that serve the needs of all learners, independent of whether they are using a desktop PC or whether they are using mobile devices (Rekkedal & Dye, 2007).

M-learning is the style of learning for the new millennium. Decreases in cost and increases in the capabilities of mobile devices have made this medium attractive for issuing knowledge. Mobile engineers, software developers, and educationists stand for the supply side of this technology, while students stand for the demand side. To further develop and improve this learning medium, it is imperative to determine students' perceptions of m-learning adoption (Iqbal & Qureshi, 2012).

The study showed that mobile learning and personal learning environments in the physics and statistics courses at the University of Alberta are transversal to all students, regardless of demographic factors, partly vindicating industrialist approaches to distance learning. Course resources are the most relevant factor shaping students' learning environments. It was also found that while social media potentiates online interaction, it does not necessarily increase study time. Evidence also points in the direction of an "always connected" pattern that has taken over the (digital) life of students (Bidarra & Sousa, 2020).

The outcomes concluded that effective need, performance expectancy, effort expectancy, social influence, and easing conditions positively impacted the management student's intent to use m-

learning. In contrast, a cognitive need was found to be insignificant in predicting and explicating m-learning adoption. To sum up, one of the novel findings of this study established the fact that effort expectancy, performance expectancy, and affective need were reported as the highest antecedents of management student's behavioural intent to adopt m-learning whereas facilitating conditions significantly impacted the m-learning adoption among students (Shukla, 2021).

The circumstances of confinement caused by the coronavirus and to ensure continuity of teaching for students; mobile learning is an essential educational technology part in higher education. It makes it possible for students to learn, collaborate, and share ideas (Naciri et al., 2020). The use of innovative technologies in the education system and the creation of a mobile learning environment in each educational institution will contribute to the fact that the young generation will grow more harmoniously in the future. Game programs offered by various companies steal the students' free time. We should consider using mobile devices as communication or entertainment gadgets for students. In that case, it will lead to increased diseases like autism among young people.

3 Use mobile applications in education

With the advent of the Covid-19 pandemic worldwide, the MIT App Inventor, recommended by the Massachusetts Institute of Technology for widespread use of digital education in higher education, has developed a mobile application for teaching "Information Technology in Education" using an intuitive, visual programming environment (Figure 1).

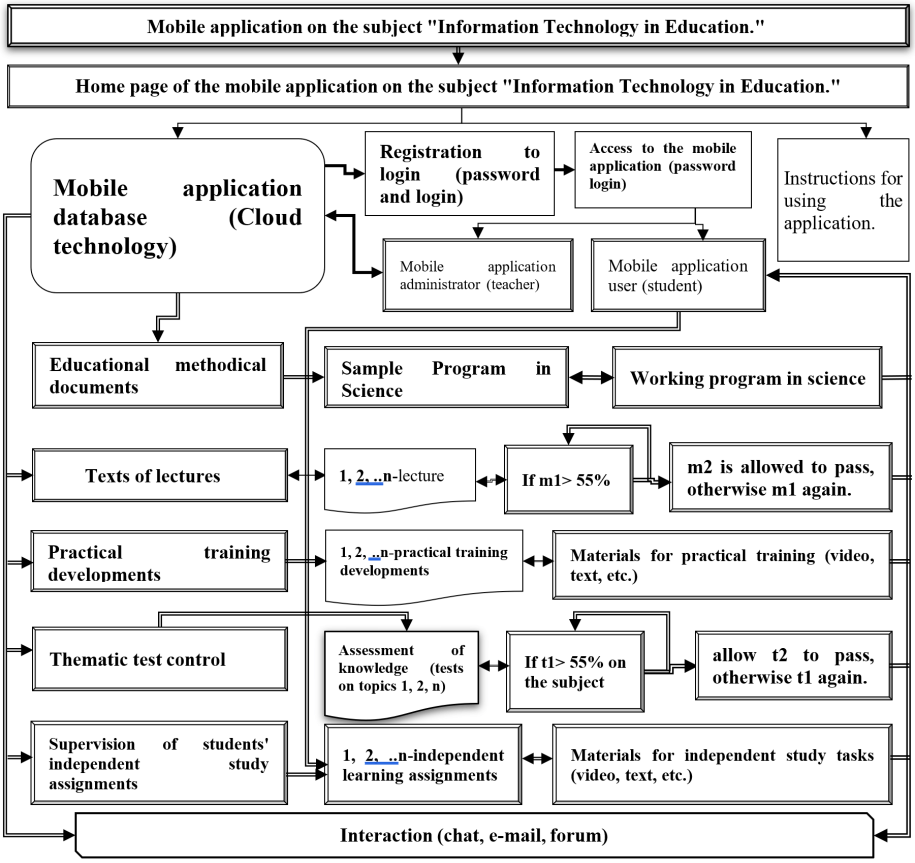

Figure 1 Model M-Learning application with cloud technology

Cloud computing has also reduced the cost associated with learning. It has made learning more thought-provoking, where learning can take place anywhere, anytime, so long as the student has access to the internet. It is hoped that developing an animated interactive mobile learning application, which introduces basic programming concepts to young children, would encourage students to continue learning outside the classroom. Educational institutes are encouraged should adopt mobile learning through cloud computing technology if the education system is to evolve (Alamri et al., 2017).

However, several issues need to be addressed before such a cloud education proposition can become a reality:

Integration – Incorporation and mobility of different tools/services/data.

(1) Assessment and Learning - Assigning who did what and who learned what becomes more complex within a networked class;

(2) Identity and Ownership - New definitions are needed for what constitutes original work, individual work, and plagiarism;

(3) Security and Privacy-Preserving mean protecting data and identity and distinguishing between professional and private data on the cloud (Hirsch & Ng, 2016).

Mobile cloud learning, a combination of mobile learning and cloud computing, is a new concept that holds considerable promise for future development and delivery in the education sector. Cloud computing helps mobile learning overcome obstacles related to mobile computing. As educators and learners see, mobile cloud learning positively influences learning. Although it may be more cumbersome for some to access the program than others, it makes it easier for more people to obtain knowledge through their mobile devices without worrying much about other hardware. In other words, mobile cloud learning brings the classroom to the student, unlike other traditional methods. It is of benefit not only to the learners but also to the educators in their classroom management (Wang et al., 2014).

Mobile cloud education is relatively new and leading-edge research and innovation, a term coined to signify the novel unification of two main domains of educational research fields, namely cloud learning and mobile learning, to be able to realize and extract its holistic cross-synergies between the two. The former is the introduction of cloud computing in education, in its delivery of the appropriate cloud contents, services, and applications for learning purposes; the latter, on the other hand, focuses on anytime-anywhere context-aware learning via portable devices, such as mobiles, tablets, and laptops, by harnessing the innovative contextual capabilities of the devices (Hirsch & Ng, 2016).

Every teacher should be aware that using mobile devices to enhance the efficiency of knowledge in the education system is a modern requirement. They are encouraged to develop mobile applications, virtual laboratories, and multimedia textbooks. When developing mobile applications, it is necessary to conduct various surveys of students on social networks. Most importantly, in a lesson organized using a mobile application, students acted actively and motivated when completing assignments (Norbutaevich, 2020b).

The modern education system requires the use of innovative teaching technologies for the effective organization of the educational process for students. Smart education is a form of education that is becoming more widespread and accepted with interest by young people in today's digital age. This reflects that education based on modern technology makes it possible to transfer knowledge and skills to students more efficiently and conveniently (Norbutaevich, 2020a).

Combining the theories of creativity and motivation and developing software that can be used for teaching at schools, is necessary for promoting creative, cloud-based mobile teaching in the future. Additionally, the learning task used in this study had a digital image design, which differs from the actual product and industrial design about materials and tools. Future studies should focus on different professional areas to examine the effects of various teaching models. In conclusion, our results could be used to enhance the effect of cloud-based m-learning on the creative performance of students engaged in various fields of study (Chang, 2019).

3.1 Assessment knowledge in M-learning

Some schools presently do not offer Adaptive learning and assessment systems (ALAS) to the students since they have a limited number of computers. ALAS requires one-on-one interaction with the computer. Our alternative lower-cost m-learning solution was developed to supply m-learning in schools that could not afford e-learning and also allows m-learning at home to support and provide additional practice to the students who used the e-learning system. M-Learning systems can support personalized learning and assessment that adapt to the users' knowledge level, preferences, and devices. Unlike most learning systems, ALAS is an integrated system that seamlessly supports personalized e-learning and m-learning (Nedungadi & Raman, 2012). The goal of using cloud-based services in education is to simplify tasks such as information processing in the virtual world, mobile learning, and the cloud programming environment (Karakose et al., 2022).

It should be noted that problems such as information capacity on servers where mobile learning resources are stored and their software updates still need to be fully resolved. These problems can be solved when a high level of hardware and software is available. Although mobile education has been used worldwide for several years, it is now being established in our republic. However, this type of education is economically the least expensive and differs from others by many applicants.

Four areas are assessed: pedagogical validity, technology, institutional policy, and research that supports the use of the technology. For this study, the pedagogical validity included an assessment of the extent to which the instruction and content were student-centred, whether it

bridges formal and informal learning, and adequately supports student assessment. Items relating to the technology include examination of infrastructure and resources to support m-learning, security of data collected, and technological ease of use. The institutional policy would need to be assessed for adequate resources and funding, alignment to appropriate standards, and professional development provided for instructors (Swanson, 2020). The practical results of the research can be seen in the development of guidelines for the use of cloud-based mobile learning and electronic information resources that create a mobile learning environment in science teaching and the development and implementation of interactive tests using cloud technology based on evaluation criteria possible. In our previous articles (Tuychi, 2022), we explored the use of cloud technologies in mobile application development(Figure 2).

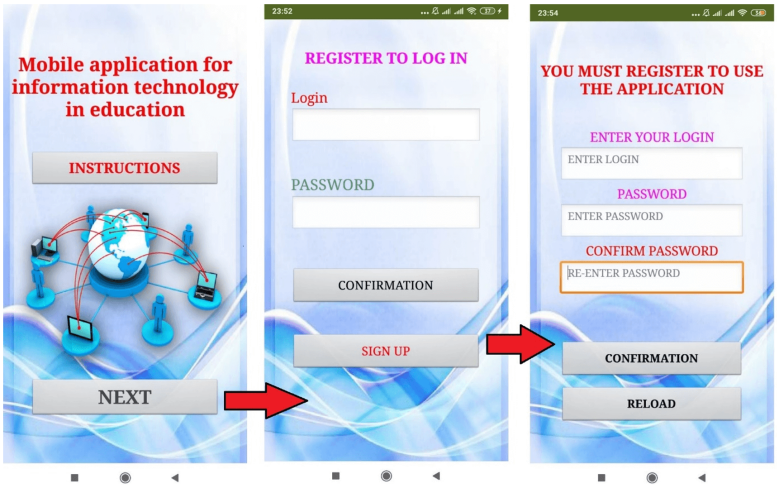

Figure 2 Mobile app login and signup windows

The mobile application provides text, video and virtual laboratory materials for lectures and practical classes. In addition, five types of tests based on cloud technology were used to evaluate knowledge in the mobile application (Figure 3).

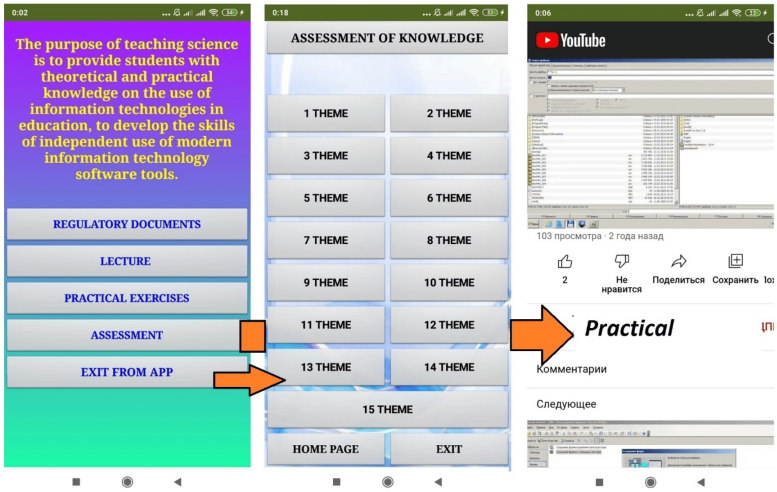

Figure 3 Assessment of knowledge in a mobile application

4 Results

That is why, under the slogan “modern education is a guarantee of competitive staff”, teachers must constantly research and work. Interactive assessment programs serve as an effective means for the teacher to “limited time in the lesson to effectively organize, and e-learning manuals should be widely used in education because of the adequate formation of the independent learning abilities of the students (Jurayev, 2020).

Students studying in groups that were accepted as an experiment were evaluated on the subject of “Information technology in education” based on a test program of a mobile application running on cloud technology, and the results were analyzed. The indicators of the beginning and end of the experiment of the students who participated in the experiment are given in Table 1. The common ethical rules were followed in the present study (Petousi & Sifaki, 2020).

Table 1 Indicators of the beginning and end of the experiment of the students

Level of ability	Experimental group		Control group	
	Beginning[1]	End[2]	Beginning[1]	End[2]
Excellent	46	80	51	33
Good	91	138	91	104
Satisfactory	99	50	97	128
Unsatisfactory	33	2	31	8

Notes: [1] At the beginning of the experience; [2] At the end of the experience.

Using the table above, we form the dynamics of assimilation by students of the situation of the beginning and end of the experimental work (Figure 4). When applying the results of research work to the educational process and calculating the indicators of the efficiency criterion according to the degree of mastering the tasks by students, the "Student criteria" was used. The general results on the application of the methodology of teaching the subject "information technologies in education" based on the blend learning technology in the Navoi State Pedagogical Institute, Namangan State University, and Karshi State University showed that the efficiency of mastering the students of the experimental group is 1.14 times higher than that of the students of the control group (Table 2).

Mathematical and statistical analysis of the generalized final results was expressed using the student's criteria: $X_T^* = 4.10$ - experimental group, $X_H^* = 3.60$ - control group.

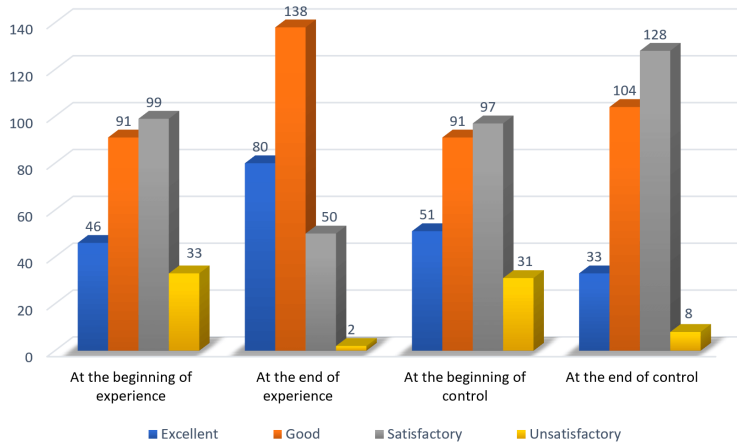

Figure 4 Dynamics of mastering the discipline "Information technologies in education" by students

Table 2 Efficiency of mastering the students of the experimental group and control group

	Experimental group (N_T = 270)				Control group (N_H = 269)			
Rating Value	5	4	3	2	5	4	3	2
Number of eligible grades	80	138	50	2	33	104	124	8
Arithmetic mean of grades	X^*_T = 4.10				X^*_H = 3.60			
Efficiency coefficient	$\eta = X^*_T/X^*_H = 1.14$							
Reliability probability range of X	$4.08 < X^*_T < 4.11$				$3.59 < X^*_H < 3.61$			

It was noted that the arithmetic mean in the experimental group is higher than that in the control group, and the efficiency coefficient $\eta = \frac{X_T^*}{X_H^*} = \frac{4.1}{3.6} = 1.14$, as we can see the equality (Figure 5).

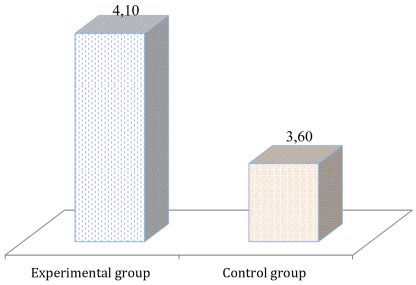

Figure 5 Schematic representation of the general statistical analysis of the pedagogical experiment-control work carried out in universities

Based on the indicators mentioned above, the assimilation efficiency coefficient obtained is greater than 1 ($\eta = 1.14 > 1$). Thus, the results of experiments have shown that the use of teaching methods based on the proposed "blend learning" technology in teaching the subject "Information Technology in Education" gives good results.

5 Discussion

To improve the educational activity of students on the subject "Information Technology in Education" based on digital technologies, the following conclusions were presented:

(1) Scientific works on the organization of the educational process based on digital technologies and the improvement of educational and cognitive activities of future teachers, as well as the use of educational technology "blend learning" in the educational process to improve educational and cognitive activities in the discipline "Information Technologies in Education" have been studied.

(2) The application for mobile learning on the subject "Information Technologies in Education", created based on the Android system, will contribute to the formation of future teachers' competencies for the effective use of digital technologies in their professional activities, as well as the training of qualified personnel of the demanded level.

(3) In the study of ensuring the integration of educational software with cloud technologies, the mutual exchange of databases of cloud technologies with distance and mobile learning based on the principle of liberalism in the implementation of knowledge assessment processes supplies an online presentation of the learning results of all students. It creates the basis for increasing students' intuition. The conscious independent use of the accumulated experience and the provided educational material in mobile learning is a prerequisite for the emergence of adaptation to a responsible educational process.

(4) In the course of studying and analyzing research on the problems of improving the pedagogical and psychological foundations for ensuring the effectiveness of educational and cognitive activity of students, manipulative, imperative ways of using digital technologies in education have been identified, it has been proven that such foundations as problem gambling have to be clarified and eliminated on and that these studies are becoming constantly relevant with technical progress. The pedagogical and psychological foundations for using digital technologies in improved educational materials ensure the formation of responsibility in students and the improvement of practical readiness for practical activities.

(5) The study of the new capabilities of the Moodle system used in the higher education system of the Republic during the pandemic, and the demonstration, using the H5P system as an example, of the synchronous method of assessing knowledge when organizing video lessons, expanded the choice of students on the use of digital technologies in the educational process.

(6) To improve students' educational and cognitive activity based on mobile technologies, the results of the approbation were scientifically substantiated and confirmed by the relevant conclusions that the student proficiency in the subject teaching methodology based on the "blend learning" technology increased by 14%.

6 Recommendations

To improve students' educational and cognitive activity based on digital technologies, it is necessary to follow the following recommendations.

(1) In higher education with a bachelor's degree, it is necessary to ensure that the curriculum for the subject "information technologies in education" are developed in cooperation with experienced teachers and ICT specialists.

(2) The improved methodological support of the discipline "Information Technologies in Education" developed during the study and the use of a dynamic online platform and interactive mobile applications in the educational process serve to form the level of a competency-based approach to the use of digital technologies in professional activities.

(3) In connection with the invaluable contribution of information and communication technologies to the development of the education system and the organization in the system of dual education, we consider it necessary to carry out admission to distance learning in the areas of bachelor's degree both in higher education and in taking into account the needs of a modern professional customer.

(4) To introduce digital education in our country, it is necessary to provide technical means for working with an extensive database (big database) and increase the speed of the Internet on the territory of the Republic.

(5) Using mobile devices in higher education and other types of education can bring effective results.

Conflicts of interest

The author declares that they have no conflict of interest.

References

Acharya, A., & Sinha, D. (2013). Assessing the Quality of M-Learning Systems using ISO/IEC 25010. International Journal of Advanced Computer Research, 3(3), 2277-7970.

Adinda, D., & Mohib, N. (2020). Teaching and instructional design approaches to enhance students' self-directed learning in blended learning environments. Electronic Journal of E-Learning, 18(2), 162-174. https://doi.org/10.34190/EJEL.20.18.2.005

Al-Adwan, A. S., Al-Madadha, A., & Zvirzdinaite, Z. (2018). Modeling students' readiness to adopt mobile learning in higher education: An empirical study. International Review of Research in Open and Distance Learning, 19(1), 221-241. https://doi.org/10.19173/irrodl.v19i1.3256

Alamri, S., Meccawy, D. M., Khoja, B., & Bakhribah, H. (2017). Learning Anytime, Anywhere: Benefits and Challenges of M-Learning through the Cloud. IARJSET, 4(5). https://doi.org/10.17148/IARJSET.2017.4508

Ali, R. A., & Mohd Arshad, M. R. (2018). Empirical analysis on factors impacting on intention to use M-learning in basic education in Egypt. International Review of Research in Open and Distance Learning, 19(2), 253-270. https://doi.org/10.19173/irrodl.v19i2.3510

Alsswey, A., Al-Samarraie, H., El-Qirem, F. A., & Zaqout, F. (2020). M-learning technology in Arab Gulf countries: A systematic review of progress and recommendations. Education and Information Technologies, 25(4), 2919-2931. https://doi.org/10.1007/s10639-019-10097-z

Barianos, A. K., Papadakis, A., & Vidakis, N. (2022). Content manager for serious games: Theoretical framework and digital platform. Advances in Mobile Learning Educational Research, 2(1), 251-262. https://doi.org/10.25082/AMLER.2022.01.009

Bidarra, J., & Sousa, N. (2020). Implementing Mobile Learning Within Personal Learning Environments: A Study of Two Online Courses. International Review of Research in Open and Distance Learning, 21(4), 182-198. https://doi.org/10.19173/irrodl.v21i4.4891

Chaldi, D., & Mantzanidou, G. (2021). Educational robotics and STEAM in early childhood education. Advances in Mobile Learning Educational Research, 1(2), 72-81. https://doi.org/10.25082/AMLER.2021.02.003

Chang, Y. S. (2019). The mediating role of motivation for creative performance of cloud-based m-learning. Australasian Journal of Educational Technology, 35(4), 34-45. https://doi.org/10.14742/ajet.4418

Clapp, A. (2017). An e-learning team's life on and offline: A collaborative self-ethnography in postgraduate education development. Electronic Journal of E-Learning, 15(1), 33-45.

Dahal, N., Manandhar, N. K., Luitel, L., Luitel, B. C., Pant, B. P., & Shrestha, I. M. (2022). ICT tools for remote teaching and learning mathematics: A proposal for autonomy and engagements. Advances in Mobile Learning Educational Research, 2(1), 289-296. https://doi.org/10.25082/AMLER.2022.01.013

Dahri, N. A., Vighio, M. S., Alismaiel, O. A., & Al-Rahmi, W. M. (2022). Assessing the Impact of Mobile-Based Training on Teachers' Achievement and Usage Attitude. International Journal of Interactive Mobile Technologies, 16(9), 107-129. https://doi.org/10.3991/ijim.v16i09.30519

Dahri, N. A., Vighio, M. S., Al-Rahmi, W. M., & Alismaiel, O. A. (2022). Usability Evaluation of Mobile App for the Sustainable Professional Development of Teachers. International Journal of Interactive Mobile Technologies, 16(16), 4-30. https://doi.org/10.3991/ijim.v16i16.32015

Dewi, N. R., Magfiroh, L., Nurkhalisa, S., & Dwijayanti, I. (2019). The development of contextual-based science digital storytelling teaching materials to improve students' critical thinking on classification theme. Journal of Turkish Science Education, 16(3), 364-378. https://doi.org/10.12973/tused.10288a

Drolia, M., Papadakis, S., Sifaki, E., & Kalogiannakis, M. (2022). Mobile learning applications for refugees: a systematic literature review. Education Sciences, 12(2), 96. https://doi.org/10.3390/educsci12020096

Gómez-Ramirez, I., Valencia-Arias, A., & Duque, L. (2019). Approach to M-learning acceptance among university students: An integrated model of TPB and TAM. International Review of Research in Open and Distance Learning, 20(3), 141-164. https://doi.org/10.19173/irrodl.v20i4.4061

Hirsch, B., & Ng, J. W. (2011, December). Education beyond the cloud: Anytime-anywhere learning in a smart campus environment. In 2011 international conference for internet technology and secured transactions (pp. 718-723). IEEE.

Iqbal, S., & Qureshi, I. A. (2012). M-learning adoption: A perspective from a developing country. International Review of Research in Open and Distance Learning, 13(3), 147-164. https://doi.org/10.19173/irrodl.v13i3.1152

Juraev, T. (2022). Problems Of Integration of Pedagogical Software With Cloud Technologies (example of m-learn). Central Asian Journal Of Education and Computer Sciences (cajecs), 1, 1.

Jurayev, T. (2020). Interactive methods of assessment of knowledge on the basis of digital education on the subject "Information technology in education." International Journal Papier Public Review, 1(2), 71-77. https://doi.org/10.47667/ijppr.v1i2.33

Kalogiannakis, M., & Papadakis, S. (2017). A proposal for teaching ScratchJr programming environment in preservice kindergarten teachers. In Proceedings of the 12th Conference of the European Science Education Research Association (ESERA) (pp. 21-25).

Karakose, T., Kocabas, I., Yirci, R., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2022). The Development and Evolution of Digital Leadership: A Bibliometric Mapping Approach-Based Study. Sustainability, 14(23), 16171. https://doi.org/10.3390/su142316171

Karakose, T., Ozdemir, T. Y., Papadakis, S., Yirci, R., Ozkayran, S. E., & Polat, H. (2022). Investigating the relationships between COVID-19 quality of life, loneliness, happiness, and internet addiction among K-12 teachers and school administrators-a structural equation modeling approach. International Journal of Environmental Research and Public Health, 19(3), 1052. https://doi.org/10.3390/ijerph19031052

Karakose, T., Tülübaş, T., & Papadakis, S. (2022). Revealing the Intellectual Structure and Evolution of Digital Addiction Research: An Integrated Bibliometric and Science Mapping Approach. International Journal of Environmental Research and Public Health, 19(22), 14883. https://doi.org/10.3390/ijerph192214883

Kibuku, R. N., Ochieng, D. O., & Wausi, A. N. (2020). E-learning challenges faced by universities in Kenya: A literature review. Electronic Journal of E-Learning, 18(2), 150-161. https://doi.org/10.34190/EJEL.20.18.2.004

Krull, G., & Duart, J. M. (2017). Research trends in mobile learning in higher education: A systematic review of articles (2011 - 2015). International Review of Research in Open and Distance Learning, 18(7), 1-23. https://doi.org/10.19173/irrodl.v18i7.2893

Kukulska-Hulme, A. (2007). Mobile usability in educational contexts: What have we learnt? International Review of Research in Open and Distance Learning, 8(2). https://doi.org/10.19173/irrodl.v8i2.356

Lavidas, K., Petropoulou, A., Papadakis, S., Apostolou, Z., Komis, V., Jimoyiannis, A., & Gialamas, V. (2022). Factors affecting response rates of the Web survey with teachers. Computers, 11(9), 127. https://doi.org/10.3390/computers11090127

Lazarinis, F., Karatrantou, A., Panagiotakopoulos, C., Daloukas, V., & Panagiotakopoulos, T. (2022). Strengthening the coding skills of teachers in a low dropout Python MOOC. Advances in Mobile Learning Educational Research, 2(1), 187-200. https://doi.org/10.25082/AMLER.2022.01.003

Maharjan, M., Dahal, N., & Pant, B. P. (2022). ICTs into mathematical instructions for meaningful teaching and learning. Advances in Mobile Learning Educational Research, 2(2), 341-350. https://doi.org/10.25082/AMLER.2022.02.004

Maksum, A., Wahyuni, E. N., Aziz, R., Hadi, S., & Susanto, D. (2022). Parents' and children's paradoxical perceptions of online learning during the Covid-19 pandemic. Advances in Mobile Learning Educational Research, 2(2), 321-332. https://doi.org/10.25082/AMLER.2022.02.002

Manurung, E. M., Purwadi, Y. S., & Sugiharto, I. B. (2022). Digital Learning Process: Challenges for Specific Creativity. Electronic Journal of E-Learning, 20(2), 112-119. https://doi.org/10.34190/ejel.20.2.2107

Mayhuay, E., & Cruz, D. La. (2023). Mobile application to improve the learning of secondary school students Literature review. 3(1), 586-595. https://doi.org/10.25082/AMLER.2023.01.007

Naciri, A., Baba, M. A., Achbani, A., & Kharbach, A. (2020). Mobile Learning in Higher Education: Unavoidable Alternative during COVID-19. Aquademia, 4(1), ep20016. https://doi.org/10.29333/aquademia/8227

Nedungadi, P., & Raman, R. (2012). A new approach to personalization: Integrating e-learning and m-learning. Educational Technology Research and Development, 60(4), 659-678. https://doi.org/10.1007/s11423-012-9250-9

Norbutaevich, J. T. (2020a). Use of Digital Learning Technologies in Education on the Example of Smart Education. Journal La Edusci, 1(3), 33-37. https://doi.org/10.37899/journallaedusci.v1i3.193

Norbutaevich, J. T. (2020). Use Of Mobile Applications In The Process Of Teaching Information Technology. European Journal of Research and Reflection in Educational Sciences, 8(6), 100-106.

Okai-Ugbaje, S. (2021). Towards a pedagogical and sociotechnical framework for the strategic integration of mobile learning in higher education in low and middle income countries. Higher Education Research & Development, 40(3), 581-598. https://doi.org/10.1080/07294360.2020.1773768

Okai-Ugbaje, S., Ardzejewska, K., Imran, A., Yakubu, A., & Yakubu, M. (2020). Cloud-Based M-Learning: A Pedagogical Tool to Manage Infrastructural Limitations and Enhance Learning. International Journal of Education and Development using Information and Communication Technology, 16(2), 48-67.

Osman, M. E. T. (2010). Virtual tutoring: An online environment for scaffolding students' metacognitive problem solving expertise. Journal of Turkish Science Education, 7(4), 3-12.

Papadakis, S. (2018). Is pair programming more effective than solo programming for secondary education novice programmers?: A case study. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 13(1), 1-16. https://doi.org/10.4018/IJWLTT.2018010101

Papadakis, S. (2021). The impact of coding apps to support young children in computational thinking and computational fluency. A literature review. In Frontiers in Education (p. 183). Frontiers. https://doi.org/10.3389/feduc.2021.657895

Papadakis, S., & Kalogiannakis, M. (2017). Evaluation of Greek Android mobile applications for preschoolers. Preschool and Primary Education, 5(2), 65-100. https://doi.org/10.12681/ppej.11208

Papadakis, S., Vaiopoulou, J., Sifaki, E., Stamovlasis, D., Kalogiannakis, M., & Vassilakis, K. (2021). Factors That Hinder in-Service Teachers from Incorporating Educational Robotics into Their Daily or Future Teaching Practice. In CSEDU (2) (pp. 55-63). https://doi.org/10.5220/0010413900550063

Park, Y. (2020). A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. International Review of Research in Open and Distributed Learning, 12(2), 78-102. https://doi.org/10.19173/irrodl.v12i2.791

Petousi, V., & Sifaki, E. (2020). Contextualizing harm in the framework of research misconduct. Findings from a discourse analysis of scientific publications, International Journal of Sustainable Development, 23(3-4), 149-174. https://doi.org/10.1504/IJSD.2020.10037655

Qashou, A. (2021). Influencing factors in M-learning adoption in higher education. Education and Information Technologies, 26(2), 1755-1785. https://doi.org/10.1007/s10639-020-10323-z

Qureshi, A., & Qureshi, N. (2021). Challenges and issues of STEM education. Advances in Mobile Learning Educational Research, 1(2), 146-161. https://doi.org/10.25082/AMLER.2021.02.009

Rekkedal, T., & Dye, A. (2020). Mobile distance learning with PDAs: Development and testing of pedagogical and system solutions supporting mobile distance learners. International Review of Research in Open and Distributed Learning, 8(2), 1-21. https://doi.org/10.19173/irrodl.v8i2.349

Ristanto, R. H., Kristiani, E., & Lisanti, E. (2022). Flipped Classroom-Digital Game-Based Learning (FC-DGBL): Enhancing Genetics Conceptual Understanding of Students in Bilingual Programme. Journal of Turkish Science Education, 19(1), 328-348. https://doi.org/10.36681/tused.2022.124

Joebagio, H., & Akhyar, M. (2018). Teachers' perception on digital teaching material development in social science education. Journal of Turkish Science Education, 15(S), 13-21. https://doi.org/10.12973/tused.10252a

Sarrab, M., Al Shibli, I., & Badursha, N. (2019). An empirical study of factors driving the adoption of mobile learning in Omani higher education. International Review of Research in Open and Distributed Learning, 17(4), 331-349. https://doi.org/10.19173/irrodl.v17i4.2614

Shih, Y. E. (2007). Setting the New Standard with Mobile Computing in Online Learning. The International Review of Research in Open and Distributed Learning, 8(2). https://doi.org/10.19173/irrodl.v8i2.361

Shukla, S. (2021). M-learning adoption of management students: A case of India. Education and Information Technologies, 26(1), 279-310. https://doi.org/10.1007/s10639-020-10271-8

Swanson, J. A. (2020). Assessing the Effectiveness of the Use of Mobile Technology in a Collegiate Course: A Case Study in M-learning. Technology, Knowledge and Learning, 25(2), 389-408. https://doi.org/10.1007/s10758-018-9372-1

Wang, M., Chen, Y., & Khan, M. J. (2014). Mobile cloud learning for higher education: A case study of moodle in the cloud. International Review of Research in Open and Distance Learning, 15(2), 254-267. https://doi.org/10.19173/irrodl.v15i2.1676

Yazıcı Arıcı, E., Keskin, H. K., Papadakis, S., & Kalogiannakis, M. (2022). Evaluation of Children's Discourses Regarding Imaginary Companion: The Case of Türkiye. Sustainability, 14(24), 16608. https://doi.org/10.3390/su142416608