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## **Using mobile technologies in distance learning: A Scoping Review**

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**Abstract:** The technical capabilities of mobile devices today make it possible to use them in the educational process. High-speed Internet and the capabilities of mobile applications allow students to have access to the necessary information at a convenient time for them. The purpose of the systematic review was the analysis and synthesis of publications on the topic of using mobile learning. In the course of the work, 34 publications of original research were analyzed, which were selected according to the requirements for narrative reviews. The search for sources for the review was carried out on the Scopus and Web of Science platforms, and specific keywords were used: mobile learning, "m-learning", "higher education", "on-site learning". For review, we selected only articles from 2019-2024. In this way, we got acquainted with the issues of introducing mobile learning into the educational process today. According to the results: the issue of the impact of



mobile learning was studied by scientists most often and accounted for 43% of the studied literature sources. The issue of students' perception of mobile learning in the publications we studied accounted for 23%, in 19% the goals that were set during the implementation of mobile learning were studied. In 10.5%, experts determined the factors that affect the success of mobile learning, and 5% of the publications contained information about the devices that are used when using mobile educational applications. To systematize the studied literature, we used the program PRISMA Conclusions. The use of mobile learning improves academic success, reduces anxiety and cognitive load, improves motivation and satisfaction with learning.

**Keywords:** mobile learning, m-learning, higher education, on-site learning.

## Introduction

The use of mobile devices with almost 95% coverage of the cellular Internet network is widespread, and the majority can no longer imagine their working day and even a day off without a mobile phone (Crompton & Burke, 2018). Constant improvement of modern mobile devices, development of new programs that help plan the day and determine the number of steps taken, as well as count the heart rate and record the ECG, and recently mobile programs have appeared that allow you to monitor the patient's mental state by discreetly monitoring physiological parameters - sleep, heart rate, stress level, as well as mobile applications that analyze even voice parameters, which integrates gadgets not only everyday life (Diaz-Ramos et al., 2023). The use of mobile phones today is common among 18-29-year-olds, and the majority own more than one mobile device (Crompton & Burke, 2018). COVID-19, which lasted for 2 years and the first period of the pandemic was particularly harsh and passed in isolation, for educators it meant a stop to education because no one could predict the duration of the pandemic.

During this period, innovative technologies were introduced into the education system and information platforms for distance learning were widely used, so the transition to distance education was not so difficult, and in most universities of the world it was effective. A mobile device is almost always present with a teacher and a student, which prompted educators to pay attention to a mobile device to optimize learning and teaching (Adzifome & Agyei, 2023). Changing the form of teaching allows teachers not to be limited to the classroom, but to continue communication outside of it in natural conditions, which brings the teacher and the student together more and helps the student to reveal more of his potential. Mobile learning is carried out through the use of personal mobile devices. Today, the use of smartphones for distance learning looks quite attractive due to the small size of the device, constant connection to the Internet, and ease of use (Diaz-Ramos et al., 2023).

The analysis of empirical studies conducted in recent years established that the use of mobile applications is successfully implemented in the educational system. We find such data in the works of Golshah A (2020), where the issue of the effective use of mobile applications by students of the dental faculty in mastering the diagnostic method - lateral cephalometry (Golshah



et al., 2020) is considered. The data presented by Emmanuel Arthur-Nyarko (2020) analyzes the use of mobile applications among Ghanaian college students surveyed on the effectiveness of distance learning (Arthur-Nyarko et al., 2020). The researchers note that the use of e-learning using mobile applications in African countries has improved since 2020, when the implementation of distance education became a necessity due to the Covid-19 pandemic.

In the work of Wainaina, P.K. (2019), the issue of setting up platforms for distance learning in a mobile format is being considered. The analysis of distance learning servers demonstrated a formal approach in some places regarding the uploaded content on the server (Wainaina et al., 2019). Mobile applications allow you to learn and master a foreign language effectively. In the quasi-experimental study Nicolaidou, I., Pissas, P. (2020), the use of virtual reality in foreign language learning is studied, as well as a comparative analysis of the use of simple mobile applications and applications with virtual reality (Nicolaidou et al., 2021).

The use of mobile applications in the study of natural sciences allows improving the knowledge of students and pupils. Supplementing mobile learning with methods of augmented and virtual reality allows you to gain knowledge in interesting and game forms. Bucea-Manea-Țoniș (2020) research using augmented reality demonstrates that additional digital elements are installed on the images received on their smartphone (Bucea-Manea-Țoniș et al., 2020). Virtual reality immerses you in a completely digital virtual world and today there are mobile applications that allow you to use virtual reality, making learning interesting and exciting (Vakaliuk et al., 2020). Cakmak, Y.O. (2020) for Medical Education Human Muscular Arm Avatars help to better remember anatomy.

### **Research Problem**

The conducted studies are of a fragmentary nature and consider a separate issue regarding the use of mobile devices, for example, to master a certain subject in the medical, humanitarian, and technical fields. To date, there are few publications that systematize information on the use of mobile devices in the distance learning system.

1. The use of mobile applications in education is growing simultaneously with the improvement of the technical capabilities of mobile devices, so studying the features of mobile learning is important.

2. Our study will help systematize knowledge about the use of mobile applications for education.

3. The study will help scientists, students and teachers to choose certain methodological approaches, as well as applications for learning and teaching.

4. The data obtained from the literature show that the study of the issue of mobile education has been studied in a fragmented way and there are few systematic reviews on this topic.



5. Conducting a systematic review and studying the results of empirical research will acquaint the reader with the experience of scientists, teachers and students, which can be useful in the work when using mobile learning.

### **Research Focus**

The conducted systematic review is aimed at acquainting readers with the successes of the implementation of mobile learning, the problems that arise when using this form, as well as with the possibilities of mobile applications that can be a supplement to educational programs. Also, the purpose of the study was to systematize the studied material and evaluate the current state of mobile learning.

### **Research Aim and Research Questions**

The goal of our systematic review was to conduct a systematic synthesis of research on the use of mobile learning in educational institutions.

1. Conduct a literature review on the use of mobile applications for distance learning.
2. To assess the benefits of implementing mobile learning.
3. To analyze possible problematic issues that may arise on the way to the introduction of mobile learning into the educational sector.
4. Outline the prospects of mobile learning.

### **Literature Review**

Information technologies are increasingly integrated into all spheres of human activity, and especially into education, which allows educational programs to cover the majority of the population, regardless of their place of residence. Mobile learning is defined as a form where a mobile device is used, which is always at hand with the learner, it is easy to carry and it can be turned on and off quickly, a laptop is not considered when studying the issue of mobile learning, as it does not meet the criteria of personal mobile devices.

The use of mobile applications for distance learning has a long history, but the peculiarity of mobile learning is related to the continuous technological improvement of mobile devices. The emergence of smartphones has expanded the possibilities of using mobile phones not only for communication, but also for the educational process. Recently, many mobile applications have appeared that provide the necessary information in constant access. Improvements in the quality of screens and software expand the possibilities of education seekers, and inspire the authors of mobile applications to create new ones with more advanced capabilities.

One of the most attractive aspects of creating an educational application is the possibility of adapting the process to the pace of a particular student. A modern electronic product is characterized by the fact that recognition of the student's progress and determination of his



needs occurs without the help of teachers. With the help of artificial intelligence algorithms, information that can be useful for the student is selected. A modern application for learning has a large number of audio and video materials for clarity, which greatly simplifies the educational process. The user must have access to video, audio, animation. The benefits of short videos with specific educational content can hardly be overstated, as they can be aimed at students' memorization of specific material.

The importance of the game process for effective learning cannot be overlooked. Rating is a familiar element in learning, but it remains a motivation for success. In addition, combining the account of educational applications with messengers makes it easier to use these services. Such Integration Moreover, such integration will help involve as many students as possible in the educational process and improve academic performance.

Of course, for successful learning, a student must be in the environment of other students to be able to exchange ideas, so the developers suggest that students create special chat rooms to communicate with each other. Similar chats can be created for communication with teachers.

A bibliometric analysis carried out by Yalcinkaya T., which covered the period 2002-2023 and studied the data of meta-analyses and systematic analyses, established that the use of mobile applications improves knowledge in the nursing field, increases the motivation to study of most students, and improves student satisfaction with the learning process (Yalcinkaya et al., 2023). Consideration of the implementation of mobile applications for nurses to better master resuscitation skills is carried out in research by Fijačko N. (2024). The author notes that all over the world, the medical field is being replaced by young people who are more knowledgeable in modern technologies, which makes the use of mobile devices simply a means of communication and an opportunity for continuous education of students. But the author notes that the result of the study is the statement that mobile applications improve theoretical knowledge, but do not change practical skills (Fijačko et al., 2024).

A study by Bolatli G. (2022) examined the impact of smartphone use on the academic performance of students studying the anatomy of the reproductive system and the level of anxiety. 63 students of medical universities took part in the study. The obtained results showed the effectiveness of using smartphones for mastering the topic of anatomy and reduced the level of anxiety.

Similar studies by Demir B.T. (2023) studied the results of academic achievement when studying anatomy in a traditional way and using mobile applications. Higher achievements and less cognitive load were shown by students who used mobile applications, and the level of satisfaction with learning and higher motivation to learn was also higher.

Pocan S. (2023) studied the influence of mobile learning on the success of students in the study of mathematical disciplines. Augmented reality programs have been created to improve perception. The methodology for determining the success of mobile learning used a math test, a motivation scale and interviews. Success and motivation improved significantly when using



mobile applications, but the level of anxiety according to the methodology that was applied did not change with traditional and mobile forms of learning.

Mergany N.N. (2021) studied the application of the Dental Surgical Forceps application, which was used to study dental forceps. Students' attitude to mobile learning was assessed using a Likert scale. The methodology also included the T-test for numerical parametric data and the Chi-Square test for non-parametric data. The mobile application improved the knowledge and motivation of students of the dental faculty.

Chen, Yu-Li (2020) investigated the benefits of implementing virtual reality in mobile learning for foreign language learning, and hypothesized that the success of mobile learning is related to the use of own devices. In a study involving 274 students from universities in Taiwan, self-efficacy and self-regulation were determined as components of mobile learning. The results of data processing showed that virtual reality increases motivation to study.

The use of mobile devices for learning creates all the conditions for situational learning, that is, at any moment, the learner can receive information for verification or improvement at the moment when he has the greatest opportunities for perception, including psychological ones (Sophonhiranrak, 2021).

The implementation of mobile learning, as a supplement to the traditional one, demonstrates an improvement in academic performance, motivation, and satisfaction with learning. For further implementation in the education system, it is necessary to study the issue of effective mobile applications that are used in the educational system, as well as the study of mobile learning strategies aimed at improving academic performance and reducing cognitive load.

A review of the literature on the use of mobile phones was conducted based on the data of the last five years. We focused on publications that studied the implementation of mobile learning in the educational sector.

## **Materials and Methods**

We conducted a systematic review (Hemingway & Brereton, 2009) to answer the question: What methodologies have been used in the evaluation of mobile learning? What is the impact of mobile learning on the success of education seekers, satisfaction with mobile learning. We also focused on the question of which industries have the most information about the implementation of mobile learning. And also, what mobile applications are currently used in the educational sector? During the systematic review, we used the identification and synthesis of the received information.



## **Sample and Participants**

To systematize the studied literature, we used the PRISMA program. An electronic literature search was conducted using keywords using the Scopus and Web of Science search platforms. For further processing, we selected the articles that have the highest rating according to their h-index and h-median indicators from 2019 to 2024.

## **Instruments and Procedures**

Using a systematic methodology, we conducted a narrative review of the literature on the topic of using mobile learning in the educational process. The search for sources for the review was carried out on the Scopus and Web of Science platforms, and specific keywords were used: mobile learning, "m-learning", "higher education", "on-site learning". These keywords were used as they are usually associated with the topic of research on mobile learning.

- The search terms "Mobile learning", "m-learning", "higher education", "on-site learning" were introduced.
- We selected only articles from 2019-2024 for review. In this way, we got acquainted with the issues of introducing mobile learning into the educational process today.
- Inclusion and exclusion criteria were applied: inclusion criteria: the use of mobile devices for learning, the use of personalized mobile devices during higher education, the reviewed articles were the results of original research.
- Articles that were freely available on the platform in full-text version were selected for further review.
- During the work on each publication, we chose to include in the article only reliable data that has been confirmed.
- We carefully processed the selected articles and critically evaluated the received information, which highlighted problematic issues and determined the direction of further research.

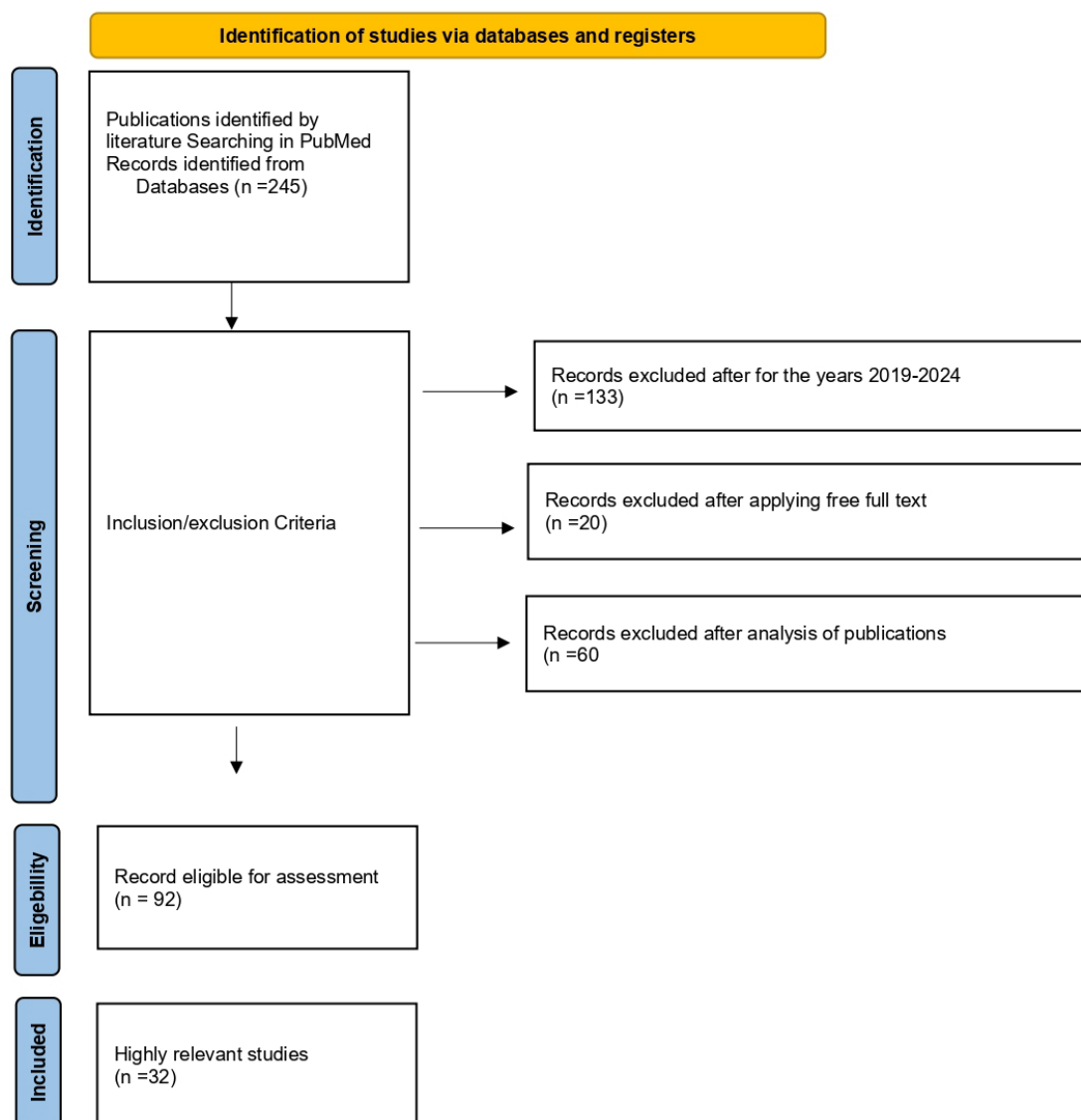
## **Data Analysis**

For processing, we chose 245 publications that were limited to the years 2019-2024, 112 of them were freely available. We chose for further processing the publications that had the following keywords: "Mobile learning", "m-learning", "higher education", "on-site learning". There were 92 such publications. During a thorough analysis, we chose for further processing 32 sources that were relevant and contributed to the understanding of the use of mobile learning methods in the educational field. The approach we used made it possible to process publications on the research topic in full and freely accessible in English for the period of the last five years on Scopus and Web of Science search platforms. (Fig. 1).



**Figure 1.**

PRISMA



## Results

The systematic review we conducted highlighted the main directions of mobile learning: the main goals of the original research conducted among education seekers, regarding: 1. The effectiveness of mobile learning on the success of students, 2. The success of students' use of personal mobile devices for mobile learning. 3. Peculiarities of pedagogical approaches for mobile learning. 4. Study of the factors that contributed to the implementation of mobile learning and 5. Consideration of programs for mobile learning.

As the next line of study, we determined what methodological approaches researchers used to find out the effectiveness of mobile learning and the questions that concerned learners when using mobile learning (Table 1).



**Table 1**

*Methodological approaches used to find out the effectiveness of mobile learning and the questions that concerned learners when using mobile learning*

Article name	The effectiveness of mobile learning on the success of students,.	The success of students' use of personal mobile devices for mobile learning.	Peculiarities of pedagogical approaches for mobile learning.	Study of the factors that contributed to the implementation of mobile learning and	Consideration of programs for mobile learning
Diaz-Ramos (2023)R	+	+			
Adzifome NS (2022)	+		+		
Golshah A (2020)	+		+		+
Nyarko A. (2020)	+	+		+	+
Criollo-C. (2021)	+		+		+
Wainaina, P.K. (2020)	+	+	+		++
Nicolaidou (2021)	+	+		+	
Bucea-Manea-Țoniș (2020)			+	+	
Vakaliuk, T.A. (2020)	+	+	+		+
Cakmak, Y.O. (2020)		+	+	+	+
Jorayeva M. (2022)	+	+			
Hedhli A. (2021)	+	+		+	
Loewen, S. (2019)		+	+		
Al-Hamad (2019)	+	+		+	
Yalcinkaya T. (2023)	+		+	+	
Fijačko N. (2023)	+		+	+	
Bolatli G. (2024)		+		+	+
Demir B.T. (2023)		+	+		
Poçan S. (2023)	+		+		
Mergany N.N. (2021)	+				+
Chen, Yu-L (2020)	+				+

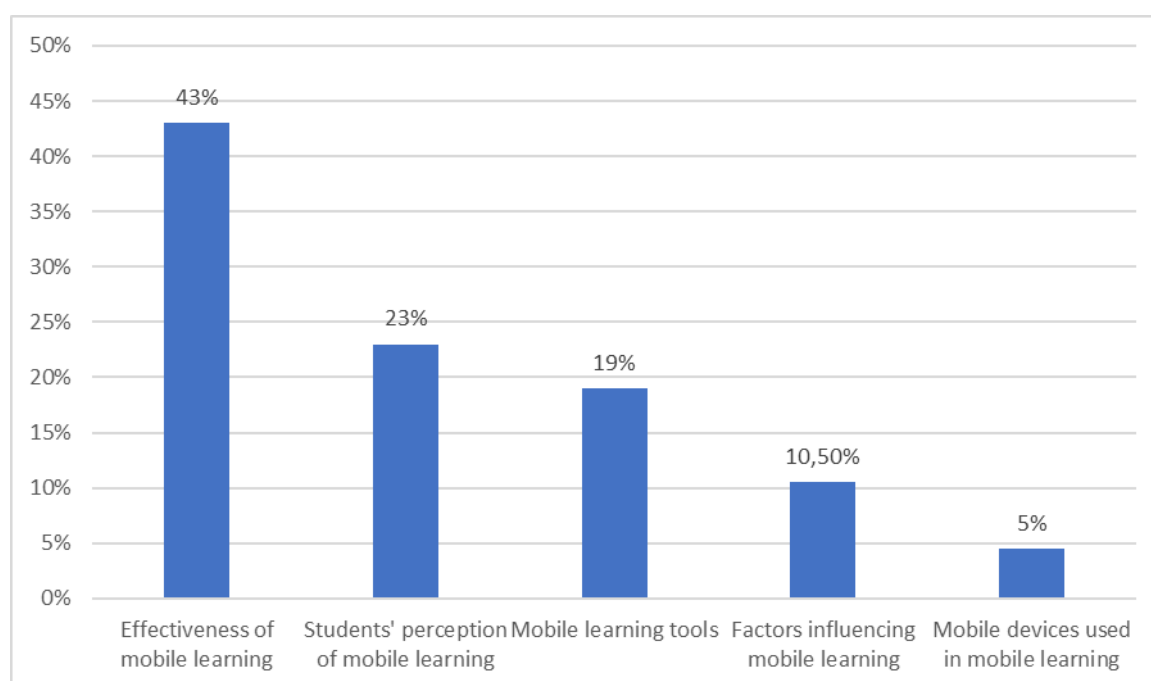


Hemingway, P. (2023)	+		+		
Rafiola R. (2020)			+		
Biswas D. (2020)		+	+		
Kirange S. (2021)	+				+
Al-Emran M. (2021)	+		+		+
Agustin W. (2021)	+		+		
Rosa R.M. (2022)			+		
Rahmawati, Y. (2022)	+	+			
Nguyen, T. C. (2021).	+			+	
Li, M. (2023)			+	+	

The question of the results of the use of mobile learning and the study of the effectiveness of mobile applications for learning disciplines was also worked out. It was studied in which fields of application of mobile learning have become the most widespread today. The advancement of mobile devices is an integral part of increasing the possibilities of mobile learning, so we studied what devices learners use when using mobile learning.

**Figure 2**

*Topics of publications on the use of mobile learning in education*



Source: Author's development.

The question of the impact of distance learning was the question that was studied most often and accounted for 43% of the studied literature sources. Qiongli Zhu (2023) studied the implementation of the Moso Teach system in the study of English at a Chinese university (Fig. 2).



The results of student surveys and questionnaires demonstrated student satisfaction with learning, and testing demonstrated improved student knowledge and, importantly for Chinese students, improved interaction between students in the group.

Ryan Rafiola (2023) studied the issue of motivation, which, according to the results of the evaluation, increased and contributed to the improvement of the performance of students of technical specialties. M. Blanca (2020) using augmented reality during mobile learning improves geometry student performance in Mexico. The issue of students' perception of mobile learning in the publications we studied accounted for 23%. Bikram Biswas (2020) studied the question of how students evaluate the possibilities of mobile learning and how they perceive this form. Research conducted among Bangladeshi students showed that the use of mobile learning among students was not properly used, but the survey found that the majority of students positively evaluate mobile learning, and experts point out that to ensure the continuity of education during pandemics such as COVID 2019, mobile training is very promising.

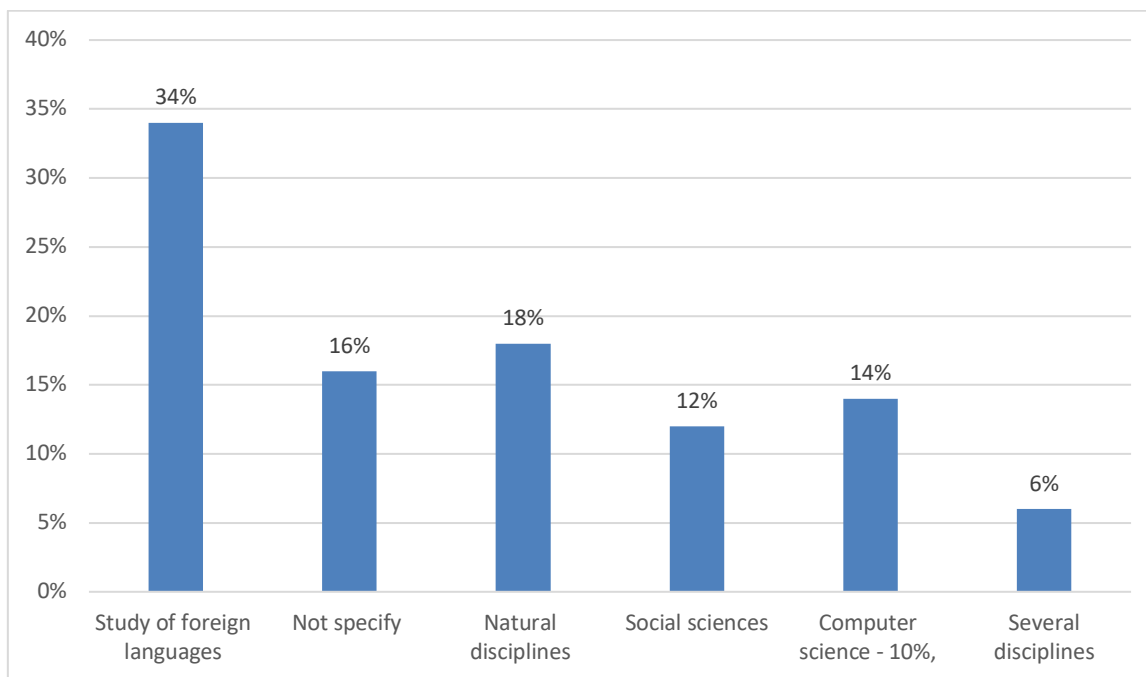
The issue of the perception of mobile technologies was also studied in the Swati Kirange (2021) research, where a model was proposed for evaluating mobile learning technologies and evaluating mobile learning platforms. The study collected 1,880 questionnaires from universities in the United Arab Emirates. The structural equation model of partial least squares and machine learning algorithms were used for evaluation (Kirange & Sawai, 2021). Studies in which questions about the goals of implementing mobile learning were studied were cited in 19% of the analyzed sources.

According to M. Al-Emran (2020), postgraduate students studying at the British University in the United Arab Emirates generally positively evaluated mobile learning, but would not be satisfied with replacing traditional learning with mobile. The use of mobile learning is widely used in the study of foreign languages. Mobile learning provides an opportunity to self-assess your achievements using self-assessment programs. In a study conducted among Indonesian students, questionnaires and documentation of the results of student achievements were conducted. The developed mobile language learning strategies have demonstrated the academic success of students, and are also related to the proposal for teachers to use mobile applications in the educational process (Agustin et al., 2021).



**Figure 3**

*Distribution of publications by educational areas*



Source: Author's development.

The implementation of mobile learning in different areas of education has its own certain distribution (Fig. 3). Mobile applications are most used in learning foreign languages and accounted for 25%. Some publications did not specify in which field mobile education is used, and this was 16%. Mobile applications are used when studying natural disciplines - 18%, social sciences - 16%, computer science - 10%, social sciences - 12%, also in some publications there was information about the implementation of several specialties -6%. The distribution of subject areas is given. For example, Swati Kirange (2021) explores the application of Khan Academy provides access to video, audio and text files and assignments for students.

Duolingo has proven itself among students and allows you to use this game-based educational application in a playful way. Among the applications used in mathematics, Byju received a spread. Any industry can use Camera Fi Live applications, which are configured for Android and can be used to view videos on YouTube, Twitch and Facebook. moreover, it has a wide range and is connected to almost any type of camera. NIIT, Coursera, Udemy, Unacademy are platforms that provide comprehensive educational services in all areas (Kirange & Sawai, 2021).

In natural sciences, mobile platforms have become widespread: iNaturalist is used to identify plants and animals, contains interactive tasks and has video materials for studying biology (Rosa et al., 2022). Research by Rosa R.M. (2022) examines the study of molluscs using iNaturalist mobile applications. PhET Interactive Simulation offers interactive programs for studying



chemistry, Chemistry 3D allows you to study the three-dimensional structure of chemical molecules (Rahmawati et al., 2022).

Physics Sandbox is used as a mobile application for studying physical phenomena. the app allows users to experiment with various physical phenomena. Other applications for studying physical processes Khan Academy Physics, which contains video lessons, files for studying physical laws (Yassine et al., 2020), Simulations Plus consists of interactive materials (Liang et al., 2021). The Khan Academy History, Crash Course World History applications are armed with interactive materials, video resources for history classes (Nguyen & Le, 2020).

Study of the issue of mobile devices used during mobile learning. Most often, in 78% of cases, mobile phones were used for mobile learning. Other studies provide data on the use of other personal devices (Li & Liu, 2023). Often the articles did not indicate that a mobile phone was used, but a mobile device was indicated, such were 18% of publications, in 9% of cases an iPad was used in 7% of cases (Fan et al., 2020). The use of mobile learning from the literary sources we analyzed demonstrated the effectiveness of this form on student success, reducing cognitive anxiety and motivation to study.

## **Discussion**

Today's youth cannot imagine their day without the use of mobile phones. Young people are more familiar with modern technologies, and some follow the appearance of new products on the gadget market in order to purchase devices that have more technical capabilities, better video and audio communication parameters. These capabilities of modern mobile devices can be used for mobile learning and a systematic review of the literature has demonstrated the high effectiveness of distance learning. Thus, according to researchers, there is a theory of technology acceptance and use to measure the factors of the effectiveness of the use and perception of mobile devices for mobile learning. Mobile applications have certain advantages over other distance learning technologies (Kang et al., 2021).

A mobile application downloaded to a mobile device is always available to the student with 24/7 access, which is important when it is not possible to visit an educational institution, especially in pandemic conditions (Bahasoan et al., 2020). The mobile application can be adapted to the individual characteristics of the applicants and take into account educational needs and create motivation for learning (Zhang & Zou, 2020). The mobile application can record achievements in mastering certain skills, which makes it possible to assess the level of knowledge and shape the direction of further training. Annual technological improvements of mobile devices and their use by young people for games have prompted specialists to create game applications for learning natural and humanitarian disciplines. Game applications provide an opportunity to master many topics in a game form (Nikolopoulou et al., 2020). Mobile applications provide feedback, so the learner can assess their strengths and weaknesses.

The research analyzed mobile applications that are used today in the study of humanitarian and natural science disciplines. Researchers have found that the main factor that increases



effectiveness when using mobile learning programs is the habit of using a mobile phone to obtain information to answer any question. So why can't it be a subject question. A survey of a large sample of students indicates that students perceive the use of mobile phones for distance learning (Islam & Hasan, 2020). The effectiveness of using mobile devices is related to the continuous improvement of technological capabilities, and software developers are inventing more advanced mobile applications for successful learning of subjects.

Thus, the use of the Duolingo application combines interactive classes, vocabulary practice, reading, listening, using cards to memorize words (Pensabe-Rodriguez et al., 2020). The use of mobile applications is widely used in the study of history, physics, chemistry, medicine, social sciences, and computer science. New programs are constantly being developed. Recently, mobile applications using augmented reality and virtual reality have appeared, which have demonstrated high effectiveness in improving academic performance, increasing motivation, and increasing learning satisfaction.

### **Conclusions and Implications**

The conducted systematic research allows us to draw conclusions that mobile learning has certain advantages over traditional, but it cannot replace traditional learning, but can only be an addition that will increase the quality of learning. Mobile learning is available to anyone who has a mobile phone and can download an application to learn a language, or learn experiments in physics, chemistry, or learn surgical medical instruments. The learner has access to the necessary materials at any time convenient for him, and can also configure the device for his individual needs, for example, listen to the audio at the required speed, view and stop the video where necessary.

Often, mobile applications have interactive forms, which improves the assimilation of the material. Mobile learning can be considered as personalized, which creates certain advantages, the student can evaluate his knowledge himself using applications, which reduces the level of anxiety during exams. In summary, mobile learning has numerous advantages that make it an attractive tool for modern education. It provides flexibility, accessibility and innovation, contributing to a more effective and exciting learning process.

### **Suggestions for Future Research**

Studying the use of mobile applications in integration with modern technologies, such as artificial intelligence, virtual reality, augmented reality, remains a promising direction. Consideration of mobile learning as a technology for continuous learning, that is, using a mobile device for information throughout life. Also, mobile learning allows you to use the capabilities of the mobile Internet and expands the circle of users who can use mobile learning, which can become a subject for further research.



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## Conflict of Interest

None.

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