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The use of mobile applications in higher education institutions to enhance the quality of the educational process

Застосування мобільних додатків у закладах вищої освіти для підвищення якості освітнього процесу

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Abstract

The article reveals the possibilities of mobile applications and experimentally proves the practicality of their use in the professional training of specialists. The popularity and significance of various mobile applications in the modern educational process have been demonstrated. The spectrum of mobile applications was analyzed, the content of mobile applications was revealed, and the most effective of them were considered, which can be useful in teaching pedagogical, natural, and humanitarian disciplines and can be used in distance learning conditions to support and motivate learning. The didactic principles that educational mobile applications must comply with are highlighted, and their advantages and disadvantages are shown. Specific forms, methods, and ways of introducing mobile learning into the educational process of a higher school

Анотація

У статті розкрито можливості мобільних додатків та експериментальним шляхом доведено доцільності їх використання у процесі професійної підготовки фахівців. Доведено популярність та розкрито значущість в сучасному освітньому процесі різноманітних мобільних додатків. Проаналізовано спектр мобільних додатків, розкрито зміст мобільних додатків, розглянуто найбільш дієві з них, які при викладанні педагогічних, природничих, гуманітарних дисциплін можуть бути корисними і які можна використовувати в умовах дистанційного навчання для підтримки та мотивації навчання. Виокремлено дидактичні принципи, яким повинні відповідати освітні мобільні додатки та доведено їх переваги і показано недоліки. Розглянуто конкретні форми, методи, способи

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were considered, which should be actively applied by teachers in the educational process of a higher school. The conducted experimental research on the importance and necessity of using mobile applications in education shows that mobile learning has become popular among young people and most university students are psychologically and technically ready for the use of educational mobile programs in education and require the mandatory use of mobile applications in the educational space of a higher school.

Keywords: mobile applications, institutions of higher education, mobile learning, training of a highly qualified specialist, modernization of the education process.

упровадження в освітній процес вищої школи мобільного навчання, які варто активно застосовувати викладачам в освітньому процесі вищої школи. Проведене експериментальне дослідження, щодо важливості та необхідності використовування мобільних додатків в освіті свідчить, що мобільне навчання стало популярним серед молоді і більшість студентів університетів психологічно і технічно готові до використання в освіті навчальних мобільних програм і потребують обов'язкового застосування в освітньому просторі вищої школи мобільних додатків.

Ключові слова: мобільні додатки, заклади вищої освіти, мобільне навчання, підготовка висококваліфікованого спеціаліста, модернізація процесу освіти.

Introduction

Integrating mobile applications into the educational process has become a significant subject of interest in recent years. This interest is due to the rapid development of mobile technologies and the spread of smartphones and tablets, which are now widely distributed among users of all ages. The effectiveness of mobile applications in education is multifaceted and covers various aspects such as academic performance, motivation, and learners' engagement. The introduction of mobile applications in education has brought significant results. Research has shown that mobile learning can increase the availability and flexibility of educational resources. Students can access study materials anytime, anywhere, which is advantageous for those juggling their studies with other responsibilities. Such convenience can contribute to increasing the time for studying and more consistent assimilation of course materials. In addition, mobile applications often contain interactive and multimedia elements such as videos, quizzes, and games, making learning more interesting and enjoyable than traditional textbooks.

Integrating mobile applications into the educational process is an important step in modern pedagogy, reflecting digital technologies' comprehensive role in contemporary society. While smartphones and tablets are becoming more common among students, using these devices for educational purposes is not only a logical development but also a necessary adaptation to the changes in the educational process. The transition to a digital educational environment opens up unique opportunities for improving the educational process, making it more interactive, accessible, and adapted to individual needs. However, transitioning from traditional methods to technology-driven education is fraught with challenges and uncertainties that must be resolved to fully realize the potential benefits (Blazhko et al., 2023).

Despite promising advantages, integrating mobile applications into the educational process is also associated with several significant challenges. One of the main challenges is the need for adequate infrastructure to support the mass use of these technologies. Schools and educational institutions should invest in providing stable Internet connections, sufficient digital devices, and technical support to ensure that all students can take advantage of mobile learning. In addition, educators must be properly trained to effectively incorporate mobile applications into their teaching strategies (Leshchenko et al., 2022).

Mobile learning with the necessary use of mobile applications is a modern direction in the educational process, which aims to create an innovative new academic environment. Due to the constant growth of the functionality of mobile devices, and the prevalence of mobile technologies in recent years, UNESCO experts suggest using the potential of mobile applications in the field of education to make education accessible and improve its quality, as well as to build an individual educational trajectory for a student of higher education (UNESCO, 2013).

The use of mobile applications in higher education institutions to improve the quality of the educational process is currently a topical issue of the theory and methodology of learning in the educational process. Based on this, we considered the following questions in the article:

1. The popularity and significance of various mobile applications in the modern educational process.
2. Didactic principles to which educational mobile applications must comply and their advantages and disadvantages.
3. Forms and methods, ways of implementing mobile learning in institutions of higher education that should be actively implemented.
4. Experimentally tested the use of mobile applications in institutions of higher education to improve the quality of the educational process.

Literature Review

Scientists from different countries are investigating using mobile learning tools in the educational process. This problem is also important for practitioners, as it is widely discussed in virtual teaching communities, at meetings, conferences, and on the pages of the methodological press. Scientists analyze the ways, methods, and specifics of the practical implementation of digital technologies in the educational process, offer their vision of mobile learning, define its essence, and convince of the need to use it in the educational process of a higher school. However, researchers have not sufficiently disclosed the specifics of using mobile applications.

The problem of training specialists to use mobile applications in higher education is quite complex, multifaceted, and interdisciplinary. Different scientists joined its solution. Thus, the issues of mobile applications in education were studied in the works of the scientists mentioned below.

The practicality of using mobile learning tools, taking into account the modern development of society, in classes in higher education institutions T. Leshchenko, O. Shevchenko, & M. Zhovnir (2022) is shown. Based on the problems of organizing the educational process, considering the tendency of students to switch to mobile portable devices (tablets, smartphones) from personal stationary computers, the relevance and effectiveness of using mobile learning tools in the educational process of higher education has been proven. Early author options for using mobile learning tools for performing practical tasks, independently mastering the material, and repeating the material outside the classroom using target platforms; smartphones. For the organization of joint activities of higher school students, using mobile devices as productive and convenient tools for accessing cloud services is proposed. L. Blazhko, I. Rassokha, & S. Rendiuk (2023) also revealed and substantiated the concept of "mobile learning", proposed their own interpretation of this term, and analyzed the directions and features of its use in modern higher education. The advantages and disadvantages of using mobile applications and electronic devices in classes in higher education are shown, which allows you to quickly check knowledge, use it for distance learning, and build the necessary schedules, to significantly increase the productivity of independent and educational work, accelerate and facilitating the acquisition of knowledge by students. Insufficient distribution in higher education institutions has been proven and said about the inadequate availability of mobile learning and mobile phones among students. The didactic principles that mobile applications must comply with are substantiated. N. Hrechanyk, O. Vasiuk, L. Matsenko, N. Folomieieva, O. Koriakin, & S. Vyhovska (2023) presented the author's vision of ways to solve educational problems and modernize higher education through the use of mobile applications and electronic devices in higher education classes; found out the possibilities of integrating digital technologies into education; identified global factors and modeled the process of transformation of today's higher education, indicated the path of development on which the global education industry is currently moving; presented a holistic vision of transformational processes in higher education.

The general methodology of research related to the use of mobile applications by physical culture teachers is highlighted in the works of O. Dyshko, V. Kovalchuk, & N. Tabak (2022). They analyze the effectiveness of future physical education teachers' use of mobile applications during students' study of tourism disciplines. The theoretical approach to the effectiveness of the use of information and communication technologies in the educational process is substantiated. It has been proven that in the context of the introduction of ICT, mobile applications are an important tool in the academic space of distance and face-to-face forms. The advantages and disadvantages of using mobile applications and electronic devices in

classes in higher education to increase the effectiveness of education are shown. The most effective mobile technologies in demand in the educational process are determined.

Preparing future teachers to use mobile applications for learning foreign languages is a new aspect of their professional training. It should be noted that the traditional approaches used for training foreign language teachers are not always appropriate in the context of the activity of a primary school teacher. That is why an important scientific task is the search for innovative technologies for teaching teachers, considering the latter's need to teach foreign languages. Considering this problem, scientists L. Moroz, V. Kovaliuk, & I. Maslo's (2023) research is devoted to using mobile applications, particularly, in learning English. The authors reveal the concept of "mobile learning" as an important educational tool in learning foreign languages. To intensify and organize the independent work of higher education students, attention is focused on the implementation of interactive technologies in the learning process, which is a promising direction in the study of languages; the experience of using mobile applications in the independent work of students is shown; an overview of mobile applications for learning English is provided.

Applying mobile applications in teaching the natural and humanitarian cycle disciplines was actively researched by A. Sustretov, V. Ignatiev, & I. Bryukhovetska (2023). They showed the role of the digital revolution, which transforms education through the use of information and communication technologies (ICT) to increase motivation and improve the learning outcomes of students; showed the influence of the penetration of mobile applications and mobile devices into education, which provides direct access to information for young people to improve the knowledge and skills of higher education seekers by introducing mobile devices into the educational process; the role of synchronizing interaction between students of education, involvement of mobile applications for additional information is substantiated. Mobile applications are suggested for studying in distance learning conditions and increasing students' motivation. The advantages that make mobile applications attractive to education seekers are identified.

The analysis of scientific sources gives grounds for the conclusion that the use and development of mobile applications, educational mobile programs, testing programs, electronic textbooks will contribute to increasing the level of academic achievements of students, will create conditions for self-education and distance education, will help activate the cognitive activity of students of higher education, solve the problem of access to new sources, will form the student's interest in the subject, provide access to a variety of information in combination with telecommunication technologies, develop independent work, make the transition to continuous education. Therefore, with the rapid development of the mobile Internet, mobile communication, mobile application markets, and multimedia services, there is a need to supplement the methodological systems of the educational process with mobile learning technologies in higher education institutions.

However, even though various aspects of vocational training specialists are constantly in the circle of scientific interests of scientists, insufficient attention is paid to the issue of training specialists to use mobile applications. In addition, the relevance of the identified problem is enhanced by several contradictions between:

- A public order for the training of teachers capable of
- Innovative activity in the educational process, and the insufficient focus of higher education institutions on solving this problem;
- The objective need for training specialists in the use of mobile applications and its insufficiently effective implementation in practice in higher education institutions;
- The necessity of forming the readiness of specialists to use mobile applications and the lack of development of content-methodical provision of such training.

So, the objective need to solve the specified problem, its insufficient theoretical and practical development, and the need to overcome the specified contradictions determined the choice of the topic of our article.

The article aims to reveal the possibilities of mobile applications and to prove experimentally the practicality of their use in the professional training of specialists.

Methodology

The methodological principles of the research are leading provisions of the theory of scientific knowledge; general scientific principles of historicism, systematicity, and scientificity; conceptual provisions of pedagogical, psychological, and sociological sciences; ideas of comparative research experience based on the simultaneous study of pedagogical, socio-cultural and economic phenomena; philosophical and pedagogical ideas of the development of modern education.

To achieve the goal, the research used the following methods:

- Theoretical – analysis of the subject of study, abstraction; definitive analysis of the problem to reveal the possibilities of mobile applications and the practicality of their use in the process of professional training of specialists;
- Empirical – the organization of observation of the object of research to ensure the profiling of the educational process and establish the effectiveness of the capabilities of mobile applications and the practicality of their use in the process of professional training of specialists,
- Special – design based on the prognosis of the main parameters of the state and development of mobile applications for the development of options for strategies for their use in the process of professional training of specialists; analysis of the specifics of the dislocation of higher educational institutions and its influence on the disclosure of the possibilities of mobile applications in the process of professional training of specialists, organization of the educational process; a pedagogical experiment to check the effectiveness of mobile applications and the practicality of their use in the process of professional training of specialists;
- Statistical – processing of research results (quantitative and qualitative data collection analysis).

The pedagogical experiment was implemented in three stages: preparatory, main, and final.

At the preparatory stage, the purpose and tasks of the research were defined, the experimental plan was developed, methods of measurement and processing of results were selected, control and experimental groups were selected, and their homogeneity was checked.

At the main stage, an experiment was conducted.

At the final stage, the experiment's results were analyzed, their reliability was confirmed, and conclusions were drawn about the pedagogical effect of the experiment.

The reliability and validity of the obtained results, and the objectivity of their assessment were ensured by the methodological soundness of the initial positions and the qualitative mechanism for evaluating the quality under study, the use of a complex of complementary research methods, and the involvement of a group of respondents from a higher educational institution in the analysis of its results.

To assess the homogeneity of experimental and control data, statistical processing was performed using MS Excel and SPSS (Statistical Package for Social Science).

An experimental study was conducted. We were interested in the opinions of teachers of higher education institutions regarding the use of mobile applications in universities. A survey was conducted among teachers of higher education institutions, in which 23 teachers of higher education institutions took part – teachers aged 25–67 years.

As a result of the survey of teachers of higher education institutions, it was established that most teachers of higher education institutions use mobile applications as educational tools in distance and face-to-face learning and understand their importance for education and human life.

To identify the effectiveness of the implementation of mobile applications in the educational process of a higher school, we conducted testing among students who were offered 25 test questions of visual recognition and 25 test tasks). To carry out the research, students were divided into groups:

- Control (n=28 people), students studied according to the traditional scheme of the educational space;

– Experimental (n=27 people), the educational process of the higher school involved the introduction of mobile applications.

Students had to answer the proposed test tasks by choosing the correct answer.

Levels of mastery of professional-oriented knowledge of higher education students corresponding to the total number of points were determined: high, average, and low.

The results of the visual recognition tests and the test questions indicate that at the end of the pedagogical experiment, better dynamics were observed in the experimental group.

The data of the experiment, thus, confirm the effectiveness of the use of mobile applications in the educational process of the higher school during the training of specialists in various fields.

We conducted an anonymous survey of higher education students to determine the place of mobile learning and mobile applications in human life and education. The fact that the study was anonymous contributed to obtaining more truthful and open statements.

When determining the sample of subjects, the general specificity of the research subject was considered. The total volume of the sample is 140 subjects. The criteria of meaningfulness, representativeness, and equivalence were considered when forming the sample. The sample was composed by random selection using the technical procedure for calculating the selection step.

Research relies heavily on the accuracy and reliability of the data. In research work, the quality of data collection and analysis adds weight to the study and contributes to the formation of sound conclusions, which is the key to academic success.

The following digital data collection tools were useful in the study:

– Google Forms – a simple survey tool that allows you to collect data from respondents, create different types of questions, and collect answers in spreadsheets.
– SurveyMonkey – a modern survey tool that offers a wide range of customization options and analytical tools for analyzing the collected data.
– JSTOR, Google Scholar, and other academic search engines provide access to scholarly articles, books, and other educational resources that may be useful for literature review and theoretical data collection.
– Zotero or Mendeley – bibliography management programs that help organize research materials, store references, and format bibliographies and citations according to different citation styles.
– Microsoft Excel or Google Sheets – spreadsheets are useful for organizing and analyzing collected data when working with quantitative data.
– SPSS, R, or Python for more advanced data analysis, statistical analysis, and processing of volumes of data.

Results and Discussion

The popularity and significance of various mobile applications in modern education.

The modern educational process puts mobile communication first in the educational process. Therefore, M-learning consists of the wide use of all the possibilities of mobile applications in the professional training of specialists. Mobile phones, tablets, and smartphones are now considered the ideal technical tools of the educational process, as they provide multi-way and two-way communication combining mobile technologies and learning strategies (Kuchai et al., 2022).

You can create and open multimedia files when learning using mobile devices, access adapted reference and learning resources via the Internet, exchange information for educational purposes, and take information from specialized sites that contain practical tasks, online tests, etc. The popularity of various mobile applications is growing along with the spread of mobile "devices" (Lerma-Noriega et al., 2023).

An autonomous software product developed specifically for mobile devices is a mobile application that aims to optimize user life tasks or solve an educational problem. A mobile application is designed for a

given platform (iOS, Android), the mobile application is distributed through special application stores (Google Play, Apple App Store) and installed on the device exactly like a computer program (Bilous, 2018). For mobile electronic devices, learning how to use applications in modern conditions of the educational process in institutions of higher education is especially relevant (Correa Cruz et al., 2017). A large number of programs are available to users of mobile devices to study any subject. The teacher's task is to individualize the learning process and help students choose products that will maximally contribute to learning designed the problem (Moroz et al., 2023).

Having analyzed the range of mobile applications, we claim that there are mobile applications that can be useful in teaching pedagogical, natural, and humanitarian disciplines, and that can be used in distance learning conditions to support and motivate learning:

- ***Khan Academy Biology***: the application contains interactive video classes and tasks, and other resources for studying pedagogical, natural, and humanitarian disciplines;
- ***iNaturalist***: allows students and any users to identify animals, insects, plants, and other wildlife objects using the phone's camera;
- ***Khan Academy Chemistry***: the application offers resources for studying chemistry, including innovative video lessons, interactive tasks, etc.;
- ***PhET Interactive Simulations***: to facilitate the understanding of chemical processes, the application offers interactive simulations;
- ***Chemistry 3D***: the application allows students of higher education to study chemical structures and will enable them to reproduce reactions in three-dimensional space;
- ***Physics Sandbox***: with the help of the application, users have the opportunity to experiment with various physical phenomena;
- ***Simulations Plus***: with the help of the application, interactive simulations are carried out, which help the students of the educational space to understand and reproduce physical processes;
- ***Khan Academy Physics***: the application offers interactive tasks, innovative video lessons, and other new resources for learning physics;
- ***The History Channel App***: the application includes historical news, articles about history, and other resources in its content;
- ***Khan Academy History***: with the help of the application, users have the opportunity to use interactive tasks, video lessons for studying history, and other resources in the educational space;
- ***Crash Course World History***: offers video classes on world history in an accessible form (Sustretov et al., 2023).

In the educational process of higher school, the use of mobile technologies is a new trend, so the theoretical base is only at the stage of development. In education, the research concerns specific scenarios of using mobile applications and mobile technologies (Shetelya et al., 2023).

Let's consider the most effective of them we offer in higher education.

1. Microblog – mobile learning scenario. The use of microblogging during classes by higher education students allows for getting answers to the questions posed, asking questions to the teacher, and discussing topics in a group, which improves the interaction between teachers and students and makes the educational process dynamic and more interactive (Tejada Campos & Barrutia Barreto, 2021).
2. Augmented reality applications, showing certain processes and concepts in a virtual environment, help to understand them better. An example can be applications that demonstrate the anatomical structures of the human body in 3D format, which will help students of socionomic specialties to understand better the interaction between organs and the structure of the human body:

    - The Anatomy 4D application provides an opportunity to see various parts of the human body in augmented reality mode, when a student can scan, for example, a poster with a skeleton image or another specific object using the camera of his tablet or smartphone, and the student of higher education sees virtual models on the screen, which can be explored in detail and rotated as convenient for the student;
    - Anatomy AR is an augmented reality application that allows users to display various components of a certain object on their screen and explore it innovatively.

3. Simulation mobile applications offer simulation games to help higher education aspirants learn various procedures and practice skills, etc.:

   – Surgery Squad is a simulation game that aims to help higher education students feel like working specialists in an interactive professional space. Graduates can perform various operations using various procedures and tools in real-time during real operations (Leshchenko et al., 2022).

Mobile applications have a high motivational potential, accommodating many forms and topics so that they can be used both for work at universities and for independent work of higher education students.

4. Free mobile applications within the curriculum developed by the British Council are designed to work on the development of grammatical skills:

   – ***Learn English Elementary Podcasts, Learn English Audio & Video, Learn English Great Videos*** – application to improve the quality of the educational process of these free mobile applications in higher education institutions, developed by the British Council within the curriculum, where the best video materials and podcasts are presented for learning the English language is of great importance for the educational process of the higher school. The advantages of these programs are additional functionalities (interactive glossaries of keywords, interactive texts of audio recordings, exercises for understanding each part of the information material), which allow you to replenish the vocabulary, improve the skills of aural perception of language, present materials of different levels of complexity;
   – ***Two Minute English, Puzzle English, Real English*** – these mobile applications are based on learning, present materials of different levels of complexity, contain a huge number of tasks and resources for work, allow to improve the skills of listening to the language, are a significant resource for students of higher education and language teachers interest, since they are also aimed at the development of speaking skills of students of higher education;
   – ***Learn English Grammar*** (British Council) – a mobile application for the development of grammar skills, which presents grammar exercises of four levels of difficulty, designed to fill the gaps in the student's knowledge, offers a multiple choice of tasks, which uses 10 types of exercises, allows comparing answers and questions ;
   – ***Learn English Grammar*** – a mobile application that is among the top ten mobile applications in more than 40 countries of the world, and 9 countries of the world it ranks first in the "Education" category AppStore;
   – ***Johnny Grammar's Word Challenge*** mobile app by the British Council – to help with quality testing of spelling, usage, ability, and vocabulary in spoken English to test your general grammar level – presents a quiz for English language learners. Tests, within three levels of difficulty, are given by categories (Words, Spelling, Grammar);
   – ***EnglishGrammarTest*** – a convenient mobile application for checking knowledge of English grammar, which offers 60 tests dedicated to a certain separate grammatical topic. In the mobile application, after completing the test, a clear and simple explanation of errors is offered, a list of incorrect and correct answers is provided, useful for self-checking;
   – ***MyWordBook*** is an available mobile application on the British Council website, presented as an interactive notebook, and serves to develop and activate the student's linguistic skills within the studied topics. Vocabulary in the mobile application is grouped into sets of interactive flashcards, presented in random order and thematic groups divided by levels of complexity.

Each interactive flashcard has fields for notes, an image, an audio example, an example of use, a translation, and a definition from the CambridgeUniversityPress dictionary. The "Practice" rubric contains five types of tasks for independent work of students of higher education, to replenish vocabulary, after completing the tasks, the user can move the word to the list of learned vocabulary (Moroz et al., 2023).

Didactic principles to which educational mobile applications must comply and their advantages and disadvantages.

Let's consider the main didactic principles that educational mobile applications must comply with:

1) Systematicity and purposefulness (revision of goals after achieving the goal by higher education seekers, clear setting of positively short-term formulated goals);

2) Individual approach (choice of the level of difficulty of tasks by students of higher education, possibility of students choosing the content of studies taking into account their interests);
3) Independence and activity (the possibility of higher education students to study independently and at a time convenient for them, in the process of group training, to show initiative with other subjects);
4) Accessibility (creating free access to programs and educational information using mobile technologies) (Horbatiuk & Tulashvili, 2013).

Let's highlight the main advantages of using mobile applications:

- Equal access to higher professional education for all participants in the educational process;
- In the process of interaction with students, feedback acceleration;
- Due to the motivated use of the mobile technology system, which is widespread – personalization in obtaining information;
- During the evaluation of educational achievements and monitoring of knowledge of education seekers – ensuring efficiency of the educational process, rational control of success of higher education seekers;
- Efficiency of time allocation during classroom learning of new material;
- Learning mobility;
- Due to adequate synchronization of mobile applications and use of various mobile devices – continuity of education;
- Effectiveness of the communication process of higher education applicants;
- Rational control of the success of education seekers (Leshchenko et al., 2022);
- Innovativeness of technologies;
- The possibility of using mobile applications as an additional means of the educational process;
- The possibility of using portable devices for educational purposes;
- The possibility to download the necessary professional material for solving tasks at a time convenient for those seeking higher education with the help of mobile applications;
- The possibility of quick access to the calculation of formulas, the construction of tables and graphs;
- Mobile applications help students to adapt to the educational process in the information space;
- The possibility of simultaneous interaction with a group of people or with one person (Rodríguez-Sarmiento, 2021).

Disadvantages of implementing mobile applications include:

1) Insufficient "technical" training in the creation of mobile applications for teachers of higher education institutions;
2) Shortage of tools for the development of mobile applications and mobile devices of high-quality educational full-featured content;
3) Additional costs for installing specialized mobile applications with advanced calculation capabilities;
4) The battery capacity of mobile devices and the limited size of displays, which is not always convenient for constructing graphs, mathematical functions, and solving complex equations;
5) Incompatibility with other mobile applications of some mobile devices;
6) Limited battery life, which means a limitation in the period, which with long-term use is a significant drawback for full-fledged long-term performance of the task (Blazhko et al., 2023).

Forms, methods, and ways of implementing mobile learning in institutions of higher education that should be actively implemented.

Let's consider specific forms, methods, and ways of introducing mobile learning into the educational process of a higher school, which should be actively used by teachers:

- The use of a ***mobile phone*** as a means of access to the global network, which allows you to organize instant access to specialized sites that offer practical tasks, tests, e-learning courses, additional educational materials (video files, photos, drawings, sound files, etc.) and give students have the opportunity to use wide opportunities to control the entire learning process, transfer of information materials, help in solving didactic problems;
- To view and ***open files of office programs*** – using special programs for mobile phone platforms (Excel, PowerPoint). The student has the opportunity to view educational versions adapted specifically for the

phone screen, having in the memory of the mobile phone files with a convenient interface, convenient scroll bars, a font that provides educational information in an interesting form;

- Specialized electronic ***textbooks and courses*** adapted for viewing on mobile phones. Applicants of higher education are offered to download applications containing information (electronic textbooks), and subject tests necessary for successful modern education to their phones;
- Reading information using ***QR codes***, when each code is in different places, and which can be used as a warm-up, a quest, or a quiz in constant motion. Students of higher education are motivated to complete tasks, use phones, pre-installed the QR-code Reader program;
- ***Learningapps.org*** is a universal tool that allows using a mobile gadget on any educational subject at all lesson stages. This site has many completed tasks that should be used in the educational and scientific activities of the student. Higher education students use the constructor on the website and create their own exercises.
- "***Word clouds", virtual boards, intellectual maps, playlists,*** and ***Google services*** – are invaluable for the educational process of a higher school – students of higher education are motivated to perform tasks, the method of application of which consists of a special visualization and method of presenting text information. In the form of a set of keywords, a text cloud, the researched educational object is described, and inscribed in a graphic figure. Such an educational approach facilitates the assimilation of new material because a higher education student associates a picture with a set of words;
- ***Microblog*** – a mobile learning scenario enables students to navigate the flow of professional terminology, receive answers to questions, post didactic material that is originally designed, discuss topics in a group, and ask questions to the teacher, which makes the educational process dynamic and more interactive and leads to interaction between students and teachers (Prado Ortega et al., 2023).

Thanks to the use of mobile learning tools, mobile applications, and mobile technologies, new forms of joint work between students of higher education and teachers are emerging, there is a rethinking of teaching methods, the interaction of methods and forms of informal and formal education, and the diversification of educational programs (Leshchenko et al., 2022).

Therefore, the constant and active use of educational mobile applications "leads to a change in the content of education, learning technology and in the relationship between the participants of the educational process, allows to individualize learning, make it more adequate to the abilities of students" (Shyshenko et al., 2021). With the help of mobile applications, it is possible to automate the learning process of introducing new approaches to the presentation of new material, by redistributing learning time, using video lessons, electronic libraries, and mobile technologies in free access and with all sources of the necessary information (Shuliak et al., 2022).

Experiment.

The results of an internet survey regarding the dynamics of using mobile and computer technologies are interesting and predictive. The results of an online study indicate the popularity of mobile portable devices. In 2013, the number of personal computers and mobile phones in the ratio averaged 34% and was almost the same.

In 2019, we are observing a change in the situation.

- The share of personal computers decreased and amounted to 23%;
- The number of portable mobile devices increased to 72%.

We can say, observing such dynamics, that the use of mobile devices is growing steadily – by 5% per year. And shortly, this trend will significantly affect education development, because mobile device use will continue to increase. The dynamic development of portable mobile devices, particularly smartphones, has created opportunities for improving the quality of education, which are unprecedented based on their use in the educational process of higher education (Nestorenko & Ostopolets, 2022).

Given the relevance of our chosen research topic now and in the future, we conducted an experimental study.

To achieve the goal, the research used the following methods:

- ***Theoretical*** – analysis of the subject of study, abstraction; definitive analysis of the problem to reveal the possibilities of mobile applications and the practicality of their use in the process of professional training of specialists;
- ***Empirical*** – the organization of observation of the object of research to ensure the profiling of the educational process and establish the effectiveness of the capabilities of mobile applications and the practicality of their use in the process of professional training of specialists,
- ***Special*** – design based on the prognosis of the main parameters of the state and development of mobile applications for the development of options for strategies for their use in the process of professional training of specialists; analysis of the specifics of the dislocation of higher educational institutions and its influence on the disclosure of the possibilities of mobile applications in the process of professional training of specialists, organization of the educational process; a pedagogical experiment to check the effectiveness of mobile applications and the practicality of their use in the process of professional training of specialists;
- ***Statistical*** – processing of research results (quantitative and qualitative data collection analysis).

We were interested in the opinions of teachers of higher education institutions regarding the use of mobile applications in universities. A survey was conducted among teachers of higher education institutions, in which 23 teachers of higher education institutions participated – teachers aged 25–67 years.

As a result of the survey of teachers of higher education institutions, it was established that most teachers of higher education institutions use mobile applications as educational tools in distance and face-to-face learning and understand their importance.

In particular, the following results were obtained:

- 89% of teachers of higher education institutions believe that mobile applications increase the motivation to study of students of higher education;
- 75% of teachers of higher education institutions recommend using mobile applications in the process of teaching professional disciplines;
- 71% of higher education institutions teachers use mobile applications as educational tools in distance and face-to-face education.

To identify the effectiveness of the implementation of mobile applications in the educational process of a higher school, we conducted testing among students who were offered 25 test questions of visual recognition and 25 test tasks). To carry out the research, students were divided into groups:

- Control group (n=28 people), students studied according to the traditional scheme of the educational space;
- Experimental (n=27 people), the educational process of the higher school involved the introduction of mobile applications.

Students had to answer the proposed test tasks by choosing the correct answer.

Levels of mastery of professional-oriented knowledge of higher education students corresponding to the total number of points were determined: high, average, and low.

Research at the ascertainment stage of the experiment made it possible to find out that at the beginning of the pedagogical experiment, there were no significant differences between the indicator of mastering knowledge (professionally oriented) among the future specialists of the experimental and control groups, which indicates the homogeneity of the control and experimental groups.

Let's emphasize the changes observed after the pedagogical experiment's end.

The results of the test questions show that:

With a low level of mastery of (professionally oriented) knowledge, the number of higher education graduates has decreased:

- In the control group by 21.2%,

– In the experimental group – by 41.1%.

The number of respondents with an average level of mastery of knowledge (professionally oriented) increased:

– In the control group by – 12.3%,
– In the experimental one – by 20.9%;

With a high level of mastery of knowledge (professionally oriented), the number of respondents increased:

– In the control group – by 11.1%,
– In the experimental group – by 25.2%.

The results of the visual recognition tests and the test questions indicate that at the end of the pedagogical experiment, better dynamics were observed in the experimental group.

The data of the experiment, thus, confirm the effectiveness of the use of mobile applications in the educational process of the higher school during the training of specialists in various fields.

We conducted another anonymous survey of higher education students to determine the place of mobile learning and mobile applications in a person's life and education. The fact that the study was anonymous contributed to obtaining more truthful and open statements.

140 students of higher education 1-3 years participated in the survey. As a result of an anonymous survey of higher education students, we received the following answers from the respondents.

1 question "Do you use reference books, dictionaries, e-books, access the Internet, play audio files?"

– 100% of respondents use handbooks, dictionaries, e-books, access the Internet, and play audio files using mobile phones;

2 question "Do you use mobile applications with the help of equipping mobile phones?"

100% of respondents use the most popular mobile applications by equipping their mobile phones, including:

– 59% of respondents use game programs with the help of mobile applications;
– 75% of respondents use mobile applications for shopping (they find goods and buy them on the Internet all over the world);
– 98% of respondents use mobile applications to watch movies together, communicate on social networks, etc. (they use applications as a way of entertainment and life);
– 98% of respondents use mobile applications to acquire new knowledge and skills using educational programs;
– 14% of respondents book accommodation, download maps, etc. with the help of mobile applications to facilitate travel;
– 21% of respondents use mobile applications to order food and drinks;
– 16% of respondents use mobile applications to scan barcodes, master, and use healthcare applications, i.e., service programs.

3 question "Are mobile applications the dominant means of learning for you?"

– 71% of respondents gave a positive answer;
– 29% of respondents gave a negative answer. This indicates the prevalence of mobile applications among students of higher education.

4 question "How often do you use mobile applications for educational purposes to improve your knowledge and skills?"

– 54% of respondents use mobile applications often (more than four times a week) to improve their knowledge and skills.

The analysis of respondents' answers regarding the importance and use of mobile applications shows that mobile learning has become popular among young people. Most university students are psychologically and technically ready to use educational mobile programs in education and require mandatory use in the academic space of a higher school.

Recommendations for teachers and students for using educational mobile applications in education.

Developed recommendations for teachers and students for the use of educational mobile applications in education:

– Mobile applications selected and offered to students must be available for use during the learning process;
– Teachers and students should be thoroughly familiar with the operation of mobile applications, know the final purpose of the application, its functions, and settings;
– Teachers and students should use mobile applications not as a replacement, but as a supplement to traditional education;
– Teachers and students should be able to choose a mobile application that meets the purpose of learning and is best suited to the discipline being studied;
– Teachers and students must use mobile applications to organize discussions at lectures to express their opinions and arguments; to study new material to provide higher education students with access to interactive simulations, and video classes, i.e. to resources that can help them understand complex processes and concepts; for project work; to consolidate knowledge;
– Teachers and students should evaluate the effectiveness of using mobile applications in the process of reflection to achieve learning goals and help in the educational process.

The research concept is based on the main scientific provisions of innovation, laws, and principles of innovative educational processes, which at the methodological, theoretical, and practical levels determine the conceptual foundations of the technology of implementing mobile applications in educational institutions.

The practical significance of the research results lies in the implementation of the technology of implementing innovations in the practice of educational institutions, in the possibility of applying the research results for scientific-methodical and informational-consultative support of the innovative activity of teachers, and in the development of their innovative competence.

The developed materials and digital content can be applied in primary school teacher training as separate modules of educational disciplines, in formal and informal education of students of higher education institutions, and the system of postgraduate pedagogical education.

Conclusions

The popularity and significance of various mobile applications in the modern educational process have been proven. The spectrum of mobile applications was analyzed, the content of mobile applications was revealed, and the most effective of them were considered, which can be useful in teaching pedagogical, natural, and humanitarian disciplines, and which can be used in the conditions of distance learning to support and motivate learning.

The didactic principles that educational mobile applications must comply with are highlighted, and their advantages and disadvantages are shown.

Specific forms, methods, and ways of introducing mobile learning into the educational process of a higher school were considered, which should be actively applied by teachers in the educational process of a higher school.

An experimental study was conducted. We were interested in the opinions of teachers of higher education institutions regarding the use of mobile applications in universities. A survey was conducted

among teachers of higher education institutions, in which 23 teachers of higher education institutions participated – teachers aged 25–67 years.

As a result of the survey of teachers of higher education institutions, it was established that most teachers of higher education institutions use mobile applications as educational tools in distance and face-to-face learning and understand their importance for education and human life.

To identify the effectiveness of the implementation of mobile applications in the educational process of a higher school, we conducted testing among students who were offered 25 test questions of visual recognition and 25 test tasks). To carry out the research, students were divided into groups: control and experimental. Students had to answer the proposed test tasks by choosing the correct answer.

The results of the visual recognition tests and the test questions indicate that at the end of the pedagogical experiment, better dynamics were observed in the experimental group.

The data of the experiment, thus, confirm the effectiveness of the use of mobile applications in the educational process of the higher school during the training of specialists in various fields.

We conducted another anonymous survey of higher education students to determine the place of mobile learning and mobile applications in a person's life and education. The fact that the study was anonymous contributed to obtaining more truthful and open statements.

The conducted experimental research on the importance and necessity of using mobile applications in education shows that mobile learning has become popular among young people and most university students are psychologically and technically ready for the use of educational mobile programs in education and require the mandatory use of mobile applications in the academic space of a higher school.

Recommendations for using educational mobile applications in education have been developed for teachers and students.

Further research is needed to substantiate the didactic principles that educational mobile applications should meet.

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