The use of mobile technologies in education with an emphasis on a student-centered approach

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***Abstract*— The use of mobile technologies for implementing a student-centered approach has become increasingly relevant in modern education. This article explores the possibilities and benefits of integrating mobile technologies into the educational process, with a focus on addressing students' needs and interests. The advantages of individualization of education, improvement of access to knowledge, stimulation of interaction and expansion of educational experience are considered. Additionally, the challenges related to the necessity of training teachers and creating appropriate resources for successful integration of mobile technologies into the learning process are addressed. This approach offers new opportunities for active and effective student engagement, stimulates their creative thinking and independence, and contributes to the development of modern skills required in today's information society. In conclusion, the importance of further research and practical implementation of the student-centered approach using mobile technologies in education is emphasized, aiming to enhance the quality of learning and students' development.**

Keywords*— *Student-centered approach, mobile technologies, education, personalized learning, mobile learning.

I. Introduction

In the modern world, information technology plays an increasingly important role in various spheres of our lives, including education. One promising research direction in pedagogy is the use of mobile technologies in the context of a student-centered approach to learning. Mobile devices such as smartphones and tablets have become an integral part of students' everyday life, providing them with access to information and communication opportunities anytime and anywhere. There is a growing need to enhance the effectiveness of the educational process in higher education, and research indicates that integrating mobile technologies can play a significant role in achieving this goal. The student-centered approach, based on the use of mobile technologies, provides an opportunity to personalize education, taking into account the needs and interests of each student. It promotes active interaction between teachers and students, as well as among students themselves, creating a conducive educational environment. In this article, we analyze the advantages of employing mobile technologies in student-centered education, including personalized learning, improved accessibility to education, stimulation of interaction, and expansion of educational experiences. Additionally, we will discuss issues related to teacher training and the creation of necessary resources for the successful integration of mobile technologies into the educational process. Our research aims to offer practical recommendations and scientific foundations for the effective use of mobile technologies in student-centered education, while also considering the challenges and prospects for further development in this field.

The conducted research has examined various aspects of applying mobile technologies in student-centered education. Chen & Tsai [1] focused on educators' perceptions of integrating mobile technologies into the educational process and their orientation towards a student-centered approach. Sandybayev [2] investigated the impact of electronic technologies on student motivation and emphasized the importance of student-oriented interaction in the context of business education. SK, W. H., et al. [3] developed an effective mobile application that promotes a student-centered learning system. Marwan et al. [4] conducted a review of mobile learning applications for students and emphasized their application in the instructional process. Rollakanti et al. [5] explored the use of technology in teaching civil engineering students and highlighted the significance of a student-centered approach. Hernandez-Velázquez et al. [6] conducted a systematic literature review on mobile learning and student-centered design. Serrano Corkin et al. [7] examined the challenges associated with teaching various subjects using student-centered technology in an urban environment. Zhang et al. [8] conducted a study on factors related to the implementation of student-centered approaches in American classrooms.

Moon et al. [9] examined the effectiveness of using student-centered iPad applications to enhance reading and comprehension skills. Capone [10] conducted a research study based on blended learning and an active learning environment, focusing on students studying STEM disciplines. Jotsov et al.

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[11] developed a virtual platform for adaptive learning based on online conferences. Nurym et al. [12] explored the application of virtual reality and Unity 3D platform for game development on the Android platform. Onyema et al. [13] investigated the potential of mobile technologies in improving the effectiveness of the inquiry-based learning method. Rapanta [14] explored the possibilities for instructors to implement a student-centered dialogic argumentation method in the instructional process. Centea & Srinivasan [15] discussed the use of mobile technologies for assessment in problem-based learning.

A study by Elsafi [16] examines the use of mobile technology for formal and informal learning. The study highlights the potential of mobile devices in facilitating the educational process outside of traditional learning environments. Zhang et al. [17] conducted research on student-centered case-based learning in master's courses in computer science, emphasizing the implementation of online and offline case discussions. Shpeizer [18] discusses the successful integration of project-based learning in higher education, considering the issues, technologies, and implementation methods involved. Wang & Song [19] investigated the impact of the collaborative pre-task stage in mobile games on the written expression of foreign language learners in a student-centered classroom. Li et al. [20] examined the factors predicting teachers' use of technology in upper secondary classes, including pedagogical and technological beliefs, attitudes, and preparedness. Arslan-Ari and Ari [21] considered the role of mobile technologies and distance learning in higher education, while Kerimbayev et al. [22] presented the use of the innovative platform I-learning in the education system. Hanafi et al. [23] focus on strengthening worship education among students in state universities through the development and implementation of a mobile learning management system using the ADDIE instructional design model. All these studies underscore the importance of a student-centered approach and the application of mobile technologies in education to achieve effective learning and student development.

II. DEVELOPMENT OF STUDENT-ORIENTED MOBILE APPS

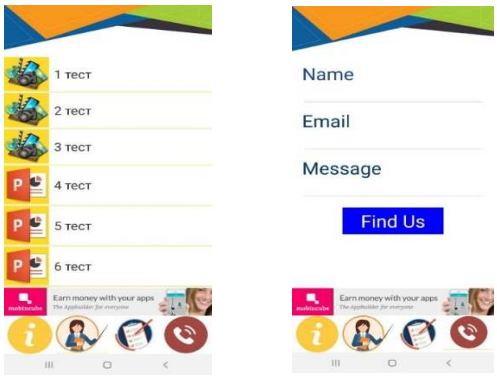
As a result of the study, the mobile application "ACT" was developed in order to implement a student-centered approach in the field of education. The application is designed for computer science lessons and provides interaction between the participants of the student-centered educational process. The implementation and testing of the mobile application in a higher education institution was conducted. The experiment included students and teachers who were offered to take computer science classes using the developed application. The app offers functionality to provide information, testing and feedback. Each student has the ability to personalize the app and receive updated content at a convenient time and place. The app also provides notifications of all events and activities taking place at the institution. Learning content includes lectures, practical assignments and tests. The interface of the mobile application is shown in Figure 1.

Fig. 1. Mobile app interface

No registration is required to use the application. The user only needs to install the application on his cell phone. After installing the application, the user has access to a menu that is simple, concise, and intuitive. Inside the mobile application there is a section "Video presentations", which contains video content developed as part of the study and covering the topics of the computer science course. All the material placed in this section is presented in ppt format and can be saved in the memory of the mobile device, which allows users to view the video content offline at any convenient time and place. The app also implements a "Theoretical Information" section, which provides an opportunity for students to expand their knowledge by reading the content provided. The interface of sections "Video presentations" and "Theoretical information" is shown in Figure 2.

a) b)
Fig. 2. Content Delivery Interface

The app features "Feedback" button functionality that allows students to ask questions of teachers and have discussions about messages both with teachers and among students. The app also contains a "Knowledge Check" section, which is designed to assess the level of students' knowledge. The test questions generated by the study allow students to test their knowledge when using the mobile app. Students can independently perform the tasks online. Tests correspond to the topics viewed in the video lessons and studied materials. The interface of the sections "Feedback" and "Testing knowledge" is shown in Figure 3.



a) b)

Fig. 3. Testing and feedback interface

The previous research experiment showed that prior to the implementation of the developed mobile app, the class of participating students had an average level of achievement. However, after the implementation of the mobile app there was a significant improvement in student performance. The developed mobile application is effective as a tool corresponding to the student-centered approach in the educational process. The implementation of this application in the learning process demonstrates its usefulness for both teachers and students. The use of the developed application in the classroom helps to increase motivation for learning through student-centered approach, which as a result contributes to the improvement of interaction between the participants of the educational process.

III. APPLICATION OF MOBILE TECHNOLOGY IN A STUDENT-CENTERED APPROACH

In the modern educational context, the use of mobile technologies is one of the promising areas of educational development. Of particular interest is their use in the student-centered approach, which emphasizes active participation and individualization of learning. In this section we will consider the impact of mobile technologies on student-centered approach and the results of research concerning this issue.

The student-centered approach in education allows to activate the role of students in the educational process, taking into account their individual needs, interests and degree of readiness to learn. Mobile technologies, such as mobile applications, provide unique opportunities to implement a student-centered approach. They allow students to access educational resources, complete assignments, and interact with instructors and other students anytime, anywhere.

Studies conducted in this area confirm the positive impact of using mobile technology in student-centered approach. For example, a study by Kerimbayev et al., [24] Garvanova et al., [25] Krouska, et al. [26] and Bai [27] showed that the use of mobile apps increases students' motivation to learn, enhances their participation, and improves academic performance. Students show more interest in the subject matter, master the material more deeply, and show more independence in their learning activities.

In addition, mobile technology facilitates individualized learning. Students can choose educational resources, assignments, and materials appropriate to their level of knowledge, interests, and educational needs. This allows each student to develop at his or her own pace and learn the learning material most effectively.

Table 1 presents the stages and key actions required for successful implementation of student-centered approach using mobile technology in the educational process. Each step is presented as a row, and the columns contain information about specific actions, responsible persons, resources and deadlines.

Table 1. Steps for implementing student-centered approach using mobile technology in education

Step	Description
Identification of needs	Identify the basic educational needs of students and areas where mobile technology can be applied.
Choice of technologies and applications	Selection of appropriate mobile technologies and educational applications that meet the learning goals and objectives.
Content Creation	Develop interactive and adaptive educational content that responds to student needs and promotes active participation.
Training support and organization	Providing support for students in the use of mobile technology, content accessibility, communication, and collaboration.
Evaluation and feedback	Evaluating the effectiveness of mobile technology, collecting data on student progress, and obtaining feedback from students.
Continuous improvement	Making adjustments and improvements based on results, feedback and new requirements.

These steps represent a general approach to implementing a student-centered approach using mobile technology in education. Each step has its own significance and requires specific attention and resources for successful implementation.

The use of mobile technology in a student-centered approach to learning is a current research area that explores the role and impact of mobile apps and devices on the educational process. In the context of this approach, mobile technologies are used to enable active interaction and personalization of student learning. Mobile apps, such as the ACT app we developed, provide students with the ability to access educational resources presented in the format of video presentations, theoretical information, and test assignments. In addition, mobile technology allows students to ask questions and discuss materials with instructors and other students through a feedback function. As a result of applying mobile technology in student-centered approach, students get the

opportunity of personalized learning, increase their motivation and improve their results in learning activities. This confirms the importance and promise of the use of mobile technology in the modern educational context.

IV. Results

In the course of our scientific research, comprehensive research procedures were conducted, including observation, documentary analysis, and surveys, in order to investigate the impact of mobile technologies on the student-centered approach in education. We collected empirical data, which served as the basis for preliminary analysis.

Within the student survey, we obtained valuable feedback and opinions regarding their preferences and experiences with the use of mobile technologies. We also conducted testing of the instructional method using mobile applications and analyzed the existing student-centered environment.

Our findings confirmed that future computer science teachers possess mobile devices such as smartphones with either Android or iOS operating systems. Moreover, students expressed a preference for using their smartphones as the primary means of accessing information, favoring them over laptops or personal computers.

Thus, our research sheds light on the importance of mobile technologies in the student-centered approach to education. The obtained results validate that the utilization of mobile technologies can significantly enhance the effectiveness of the educational process, contribute to improved student motivation and self-regulation, as well as foster the development of collaborative skills and flexible learning.

Within our research, a survey was conducted among teachers and students studying Computer Science to assess the effectiveness of a student-centered approach using mobile learning in education. To collect data, we utilized an online survey tool called Voting, which provides interactive feedback and convenient data analysis. The questionnaire included questions aimed at evaluating various aspects of the student-centered approach using mobile learning. The questions covered aspects such as the convenience of using mobile devices for learning (How often did you use mobile devices for learning? How convenient was it for you to use mobile devices for accessing educational materials and assignments?), interaction and feedback (How often did you receive feedback from teachers through mobile applications or platforms? What form of feedback was most useful for your learning?), accessibility and flexibility (How easy was it to access educational materials through mobile devices? What mobile learning features were most beneficial for your flexibility in learning?), motivation and interest (To what extent did mobile learning contribute to your motivation in studying Computer Science? What aspects of mobile learning attracted you the most and helped maintain your interest in the subject?), results and achievements (What changes in your academic performance or understanding of the subject did you notice after the implementation of mobile learning? What specific skills or knowledge have you gained through mobile learning?). Figures 4, 5, and 6 present a sample of some survey results. The analysis of questionnaire responses allowed us to assess the effectiveness of the student-centered approach using mobile learning. We were able to identify the positive and negative aspects of this approach and evaluate its impact on student motivation, learning outcomes, and satisfaction. The survey data can be utilized for further improvement of teaching methods and the development of more effective educational programs in the field of Computer Science.

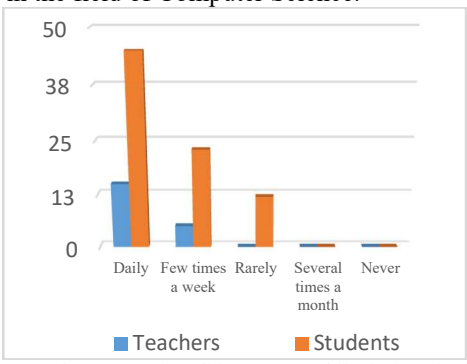


Fig. 4. Survey results - How often did you use mobile devices for learning?

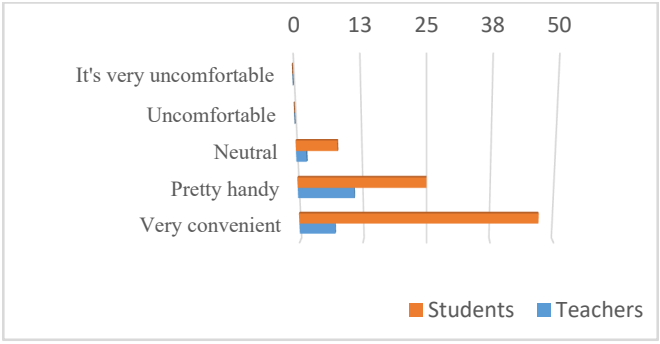


Fig. 5. Survey results - How convenient was it for you to use mobile devices for accessing educational materials and assignments?

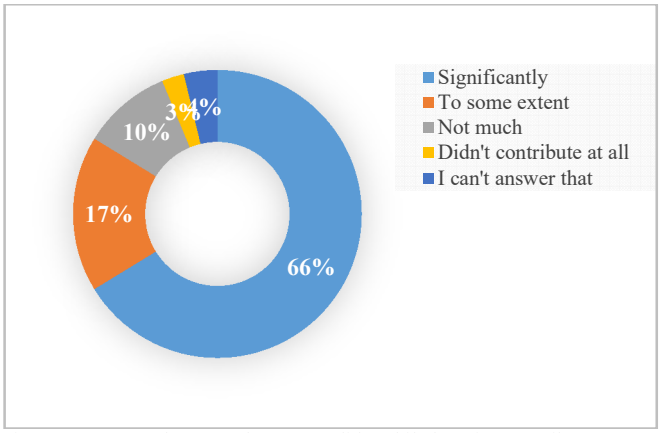


Fig. 6. Survey results - To what extent did mobile learning contribute to your motivation in studying Computer Science?

The survey was conducted anonymously during the experimental period, and the results were obtained for further analysis. At the beginning of the study, the average level of students' knowledge was 71.33%. However, after conducting the experiment using a student-centered approach and blended mobile learning, the students' knowledge level increased by

16.5%. The coefficient of variance increased from 8.38 to 27.12, indicating an increase in the diversity and distribution of results. The Pearson correlation was 0.76, indicating a strong positive relationship between the application of a student-centered approach with mobile learning and the improvement of students' knowledge level.

The experimental data confirms the effectiveness of pedagogical design incorporating a student-centered approach with the use of mobile technologies in blended learning for higher education students in the context of digitalization. The obtained results and the scientific and methodological experience can be applied in the higher education system to enhance the quality of education and the effectiveness of the educational process. A detailed analysis of the experimental research data is presented in Figure 7.

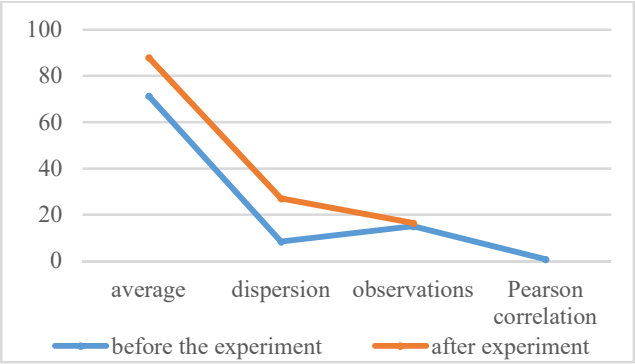


Fig. 7. Experimental data analysis

The use of a student-centered approach in digital pedagogy, using interactive classes based on innovative technologies, helps to increase the level of student learning. The main content of this approach is active dialogue and interaction, as well as the active participation of students in the process of studying the subject. One of the key advantages of this approach is the ability to create a shared experimental foundation that provides the basis for exploring more technical aspects of subjects.

The obtained results indicate a positive impact of the student-centered approach using mobile technologies on the effectiveness of student learning. This effect is determined by achievements, the degree of student engagement, and cognitive learning outcomes.

V. Conclusions

The application of student-centered approach with the use of mobile technology in education opens up new perspectives for the integration of educational educational methods in higher education. Our research revealed a desire to combine different forms of learning and integrate different methods of using mobile technologies. The purpose of this study was to develop a student-centered mobile learning environment that can be used by higher education teachers interested in conducting classes using mobile learning. The development of a methodology for a student-centered approach in mobile learning included the following steps: analysis, method development, and implementation.

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