Mobile applications as a catalyst for the digital transformation of higher education in the context of the innovation economy

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ABSTRACT*: The article discusses the main aspects of using mobile applications as a catalyst for the digital transformation of higher education in the context of the innovation economy. It is emphasized that mobile applications change traditional teaching methods and administrative processes, contributing to their efficiency. It is determined that thanks to mobile technologies, education is becoming more and more accessible, flexible, and adaptive to the requirements of the modern information society. It has been determined that modern mobile applications provide innovative tools for distance learning, allowing students and teachers to interact regardless of geographic location. This creates conditions for a continuous educational process, improving the quality of educational services and contributing to the personalization of education. However, it is noted that modern mobile applications for higher education demonstrate fragmentation, being limited to performing specific learning tasks. The lack of integration between different platforms leads to the need to switch between them to perform various actions, which creates additional difficulties for users. Particular attention is paid to the role of higher education institutions in shaping the innovation economy. Thus, educational institutions not only train highly qualified personnel but also contribute to creating new knowledge and technologies, forming an environment that supports the development of a creative society. Innovative mobile applications contribute to economic growth by creating new jobs and stimulating the development of innovative industries. They also contribute to social equality by providing equal access to quality education, especially in regions with limited resources. The report concludes that the future of higher education depends on the ability of institutions to adapt to rapidly changing conditions and implement digital innovations. Mobile applications play a key role in this process, ensuring effective learning and organization of the educational process.*

KEYWORDS - *mobile applications, digital transformation, higher education, innovative economy, personalized learning, distance learning.*

I. INTRODUCTION

Mobile applications are now becoming an indispensable tool in the process of modernizing higher education. They not only change the way we learn and interact but also contribute to the development of new forms of organization of higher education institutions. Thanks to mobile technologies, education is becoming more accessible, flexible, and adapted to the requirements of the modern information society. The digital transformation of higher education institutions, based on the widespread use of mobile applications, also allows for the optimization of both educational and administrative processes. Personalized access to educational materials, interactive tasks, and automation of routine operations help to improve the efficiency of teaching and management of an educational institution. This, in turn, contributes to the creation of a more flexible and adaptive educational system that meets the modern requirements of students and teachers.

Innovations in educational mobile applications also act as a powerful catalyst for the digital transformation of education, contributing to the competitiveness of the national economy. By creating new jobs and stimulating the development of innovative industries, such applications contribute to economic growth. At the same time, by ensuring equal access to quality education, especially in regions with limited resources, mobile applications contribute to social equality and the overall development of society. Integration of mobile applications into the educational process allows to create a flexible, adaptive, and efficient educational system that meets the requirements of the modern dynamic world.

II. DIGITAL TRANSFORMATION OF SOCIETY AND THE ROLE OF HIGHER EDUCATION INSTITUTIONS IN THE FORMATION OF AN INNOVATIVE ECONOMY

The digital revolution, which covers all spheres of social life, is inextricably linked to innovation - the result of human creativity aimed at developing new products, processes, and services. Innovations are the driving force behind economic growth and improved quality of life. Higher education institutions play a key role in shaping the innovation ecosystem. They not only train highly qualified personnel but also serve as centers of research and development, contributing to the creation of new knowledge and technologies. According to

researchers, universities are focused on creating an environment that promotes the development of a creative society that can effectively adapt to the challenges of our time [1].

Innovation in education is closely linked to the process of digital transformation [2]. Digital technologies are changing traditional methods of teaching and university management, creating new opportunities to improve the quality of educational services. The development of a digital educational environment contributes to the formation of skills necessary for successful work in the digital economy.

Digital innovations in higher education are aimed at:
 – improving the efficiency of universities, namely: optimizing administrative processes, personalizing education, expanding access to education, etc;
 – development of graduates' competencies, which includes the formation of digital competencies, critical thinking skills, creativity and cooperation;
 – strengthening the competitiveness of the national economy, promoting innovative development of industries, creating new jobs, etc.

Thus, the digital transformation of universities is an important factor in enhancing their role in society and the economy. By investing in the development of digital technologies in education, countries can secure a leading position in the global economy.

III. ARTIFICIAL INTELLIGENCE (AI) AS A DRIVING FORCE FOR PERSONALIZATION OF EDUCATION

Modern artificial intelligence technologies are significantly transforming the education paradigm, enabling a shift from a mass approach to individualized learning. Analyzing large amounts of data on student performance, individual characteristics, and learning styles allows for the development of personalized learning paths. AI systems are able to adapt the content, pace, and methods of learning to the specific needs of each student, thus optimizing the process of mastering the educational material. The potential of artificial intelligence is primarily aimed at improving the efficiency of teachers and creating more comfortable conditions for students' learning and development.

New technologies allow for more productive and creative ways of online learning. With the advent of new educational technologies, higher education institutions are simplifying their technical tools and starting to use the best available e-platforms. Artificial intelligence is changing many aspects of education, from creating individualized lesson plans to organizing assistance for teachers and students. Microlearning is becoming one of the most popular forms of interactive classes, which involves mastering a small amount of material in a short period. Typically, microlearning offers students small learning modules (up to 15 minutes) with specific learning objectives.

Among the methods and forms used in the process of microlearning are the following: applications, videos, games, infographics, and social networks. Due to the ever-growing interest in microlearning, microschools are emerging that develop and implement small independent educational programs and offer an individualized learning format. It is worth noting that the first microschools appeared in the UK as small independent schools funded from private sources by groups of like-minded parents and run by private teachers. These "didactic capsules" are home to 3 to 10 students under the tutelage of parents or private teachers. Microschools use creative teaching methods and create a close-knit, community-oriented educational atmosphere.

Another important global trend in modern education is the transition to project-based and experimental learning. This method has proven to be effective in teaching students practical skills and developing critical thinking, collaboration, and creativity.

However, online learning, despite its effectiveness, cannot completely replace traditional formats of knowledge acquisition. Therefore, virtual and hybrid learning is becoming increasingly popular. The shift to a blended learning model reflects an attempt to integrate the best of traditional and digital educational practices, offering a more personalized and accessible learning experience. There is a growing demand for online tutors who see a variety of perspectives on teaching in the digital environment.

User-generated content (UGC) is currently on the rise in online learning. UGC provides learners with an effective platform for sharing educational content and materials in an informal and comfortable environment without the need to be certified experts in the field. It is worth noting that UGC in eLearning can take many forms, including discussion forums, student-generated videos, blogs, social media channels, podcasts, and more.

It is also worth noting the significant growth of gamification in online education. Gamification is aimed at increasing engagement by introducing game elements into the learning process. These include points, badges, challenges, avatars, simulations, customization, real-time applications, and leaderboards. Such features actively encourage student participation, making the learning process more effective. It is expected that by 2032, the average annual growth rate of gamification in e-learning will be 21,5% [3].

According to some scholars, by the end of 2024, the availability of education through open-source software platforms and online learning resources, such as learning management systems (LMS), which implement interactive and personalized learning experiences using artificial intelligence and data analysis, will increase [4]. It is LMS platforms that support hybrid and blended learning models, organically combining face-to-face and online learning formats. LMS platforms also optimize and automate administrative tasks, increasing the efficiency of teachers and students.

IV. MOBILE APPLICATIONS AS THE LATEST TOOLS FOR CREATING INTERACTIVE LEARNING ENVIRONMENTS

Mobile applications are showing rapid growth in online education, providing both teachers and students with innovative learning tools. Their functionalities, including personalized access to learning materials, interactive tasks, instant feedback systems, and integration with other digital resources, help to improve the efficiency of the learning process. Such applications are especially relevant in the context of distance learning, ensuring the continuity of the educational process regardless of geographic location. Developed with security in mind, modern mobile applications for higher education use advanced encryption and data protection technologies, guaranteeing the confidentiality of users' personal information. In the context of our study, we will review the most popular mobile applications used by higher education institutions.

According to the latest data for 2023, the Coursera mobile application is the undisputed leader among students of higher education institutions around the world [5]. This free, modernized version of the popular online platform is available for users of both Android and iOS devices. The initiative to create Coursera arose in early 2012 as part of a project on mass online education proposed by Stanford University professors E. Ng and D. Koller. The platform quickly gained recognition in academic circles, and prestigious universities such as Princeton, Stanford, Michigan, and Penn State became the first partners to offer their courses on the platform.

For more than 10 years, Coursera has been actively developing, and expanding its content to include collections of courses that build specializations and allow students to dive deeper into specific subjects. The Coursera platform offers a diverse range of training programs that meet the needs of both professional retraining and personal development. The platform offers both individual courses aimed at acquiring new skills and programs leading to diplomas and degrees.

The curriculum development is ensured by a team of experts, which includes leading scientists, professors from leading universities, and specialists from leading global companies (Google, IBM, Microsoft, PwC, etc.). This guarantees the high quality and relevance of the training materials.

A key feature of the platform is its flexibility. Users can study anytime and anywhere thanks to the offline mode and intuitive interface. Regular content updates and an individualized approach to tracking student progress contribute to effective learning. According to Coursera's 2023 data, the platform united more than 124 million users who were offered more than 7,000 training programs in a wide range of disciplines: from information technology and engineering to humanities and arts [6].

The Blackboard Mobile Learn application is also worth mentioning, which is used for interactive teaching and learning on mobile devices. Thanks to a wide range of functionalities, the application allows you to access learning materials, participate in online discussions, and receive feedback from teachers anytime and anywhere. The platform offers specialized client applications for students and teachers and an adapted set of tools for each of these roles. Students can easily view learning materials, complete assignments, and interact with their classmates. Instructors, in turn, gain full control over the learning process: from publishing educational materials to grading student work and conducting online consultations. One of the key advantages of Blackboard Mobile Learn is its offline mode support, which allows students to continue their studies even when there is no Internet connection. In addition, the platform provides a high level of compatibility with various mobile operating systems (iOS, Android, Windows), making it accessible to a wide range of users [7].

Evernote is another tool that is actively used by both students and teachers in organizing online learning to create notes, including text records, web pages, task lists, photos, images, and emails. With this mobile application, you can quickly and conveniently memorize everything you want to remember and view the notes you have made from any computer or mobile phone, wherever the user is. The service is provided through a standard web browser or using a special program (local client) Evernote for Windows, Mac OS, Windows Mobile, and iPhone [8].

The Wolfram Alpha mobile application is very popular among students of European higher education institutions. Launched in 2009, this tool is a powerful computing system that provides users with the ability to get answers to a wide range of scientific and technical questions. Wolfram Alpha operates based on a vast knowledge base and sophisticated algorithms, which allows it to process both simple arithmetic operations and complex scientific calculations [9].

In the TED Conferences LLC (Technology, Entertainment, Design) Android application, the American media organization publishes speeches online for free distribution under the slogan "ideas worth spreading." The

mobile application allows you to stream and even download TED Talks directly to your mobile device. The TED video library is available with subtitles in more than 100 languages. Users can listen to episodes of the well-known online radio station TED Radio Hour, and download video and audio recordings of speeches for offline playback [10].

However, it is worth noting that modern mobile applications for higher education are fragmented, and limited to performing specific learning tasks. The lack of integration between different platforms leads to the need to switch between them to perform various actions (viewing lectures, participating in discussions, etc.), which creates additional difficulties for users. This situation leads to a loss of time, reduces the efficiency of the learning process, and makes it difficult to track learning progress. Therefore, to improve the effectiveness of online education, it is necessary to develop a comprehensive mobile application that will combine various learning functions in a single platform. This approach will ensure uninterrupted data exchange between different modules, simplify the use of applications, and allow them to be adapted to the individual needs of users. This, in turn, will make online learning more attractive and effective for all participants in the educational process.

V.   CONCLUSION

Mobile applications are becoming increasingly important in the context of the digital transformation of higher education. They are a key tool that catalyzes changes in all aspects of the educational process, from learning and interaction with teachers to administrative procedures. The integration of mobile applications into the educational environment provides several significant advantages: flexibility and adaptability, accessibility, interactivity, personalization, and automation. Due to these advantages, mobile applications help to increase the efficiency of learning, improve the quality of educational services, and allow the creation of innovative models of organizing the educational process that meet the requirements of the modern information society.

Innovative mobile applications not only transform education but also play a significant role in stimulating economic growth and increasing the competitiveness of national economies. They stimulate the development of new industries, create new jobs, and provide equal access to quality education, especially in regions with limited resources. This contributes to social equality and the overall development of society. Thanks to the constant integration of the latest technologies and innovative solutions, mobile applications are becoming an integral part of the modern educational ecosystem. They allow for a more interactive learning environment where students can interact with content and teachers in real-time. In addition, mobile applications promote inclusivity by allowing students with different needs and abilities to actively participate in the educational process, which significantly improves the quality of learning and student satisfaction.

Thus, the future of higher education largely depends on the ability of educational institutions to adapt to rapidly changing conditions and implement digital innovations. Mobile applications play a central role in this process, enabling universities to organize learning and administrative activities more efficiently. The further development of such applications will contribute to the formation of new educational models that will be more flexible and personalized, according to the individual needs of each student. This, in turn, will help to create an educational system that can respond to the challenges of the modern world, ensuring the training of highly qualified specialists who will be able to work effectively in the digital economy and contribute to its further development.

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