

## ANNOTATION

**dissertation work of Sakibayev Spartak Razakhovich on the topic «Formation of professional competencies of future teachers of mathematics with the use of mobile applications», submitted for the degree of Doctor of Philosophy (PhD) on the educational program 8D01501- «Mathematics»**

### **Actuality of the study.**

In his Address entitled «The unity of the people and systemic reforms - a solid basis for the prosperity of the country» (dated September 1, 2021) the President of the Republic of Kazakhstan Kassym-Zhomart Tokayev, formulated the main priorities of activities aimed at improving the welfare of the people of Kazakhstan. The most important and specific instructions of the Head of State are aimed, first of all, not only at improving the welfare of the population, but also relate to the areas contributing to this, in particular, education. Among the issues considered in the Address, the improvement of the quality of education and support for teachers were emphasized.

Increasing the level of professional competencies of future teachers of mathematics and, as a consequence, improving the process of student learning in higher education institutions is one of the most priority tasks of Kazakhstani higher education.

The Strategic Plan of the Republic of Kazakhstan until 2025, the Law of the Republic of Kazakhstan «On the status of a teacher» dated December 27, 2019 № 293-VI notes the need to improve the effectiveness of professional training of future teachers.

Recent reforms in the field of education strategy in Kazakhstan determine radically new approaches to the improvement and further development of the entire educational sector.

One of these reforms is the integration of the higher education system of the Republic of Kazakhstan into the Bologna process, which is a common educational space of European countries of Europe. Since 2016, there has been a process of large-scale renewal of the content of secondary education. This renewal has necessitated changes in the teaching system both in schools and universities. In this regard, the main focus of research in the field of education of the republic should be to find ways to improve the effectiveness of teaching methods. And one of the ways to achieve this goal is the use of innovative educational technologies.

Globally, educational programs permanently emphasize the importance of the ability to apply modern educational technologies to solve problems in mathematical disciplines. Many scientists and methodologists point out the problems arising due to the inconsistency of used educational technologies with the current level of information technology development. As a result, the participants of the educational process do not get the opportunity to solve mathematical problems using modern technologies that are most suitable for each specific case.

The study of the importance of introducing innovative technologies and approaches to teaching is an important subject of research of domestic and foreign scientists engaged in the problems of methodology of teaching mathematics in secondary and higher education. The works of Kazakh scientists A.E. Abylkasymova, Z.M. Moldakhmetov, A.K. Mynbaeva, Russian scientists D.M. Ismoilova, M.V. Egupova and others can be especially noted.

Kazakh scientists A.E. Abylkasymova, E.A. Tuyakov and S.M. Seitova and Russian researchers E.A. Vasilevskaya and E.S. Polat in their works note the role that innovative technologies play in the formation of mathematical competencies.

American scientists Huang R., Spector J.M. & Yang J. and Hartley emphasize the need to use such a component of innovative technologies as modern educational technologies to increase the level of effectiveness of the educational process.

Canadian scientist Cheng and German researcher Fischer notes that the priority form of using modern educational technologies is mobile educational technologies. They also note that these forms of learning, unfortunately, have not received widespread and optimal application in the modern educational process.

Because of this, there is currently a need to make serious adjustments in the process of integrating innovative mobile technologies into the educational process aimed at training mathematics educators at universities in the country.

Today the Republic of Kazakhstan faces a difficult task of implementing long-term strategic projects aimed at making the country one of the 30 developed countries of the world by 2050. Along with economic resources, one of the most important tasks is to increase the level of spiritual potential of human capital.

Modernization of education in Kazakhstan in recent years is undergoing a serious renewal. The main goals of the ongoing reforms in Kazakhstan's education system are the formation and implementation of approaches aimed at improving the quality of education, which cannot be achieved without improving the professional competencies of mathematics teachers, namely such a component as information competencies. One of the most effective ways to achieve these goals is the use of innovative educational technologies, which in this dissertation are understood, first of all, as mobile information technologies. Innovative educational technologies develop students' independent learning and critical thinking skills and improve their academic performance. In connection with the above-mentioned points, the education system, the system of criterion evaluation and the format of the Unified National Testing are being updated on the basis of the «State obligatory standard of education at all levels of education».

The conducted analysis of researches on the use of innovative educational technologies in the process of teaching mathematics in educational institutions and the problems of improving the professional training of mathematics teacher in pedagogical universities allowed to identify the following contradictions:

1. Between the need of modern society in highly qualified teaching staff and the need to strengthen the level of integration of innovative mobile educational technologies in the process of teaching mathematics in higher education;
2. Between the need for a unified criterion approach to assessing the degree of formation of professional competencies of future teachers of mathematics and insufficient reflection of the role of innovative mobile technologies as a factor of such assessment;
3. Between the need for methodological training of future teachers of mathematics to use innovative mobile technologies and insufficient development of the methodology of mobile applications in universities.

The mentioned contradictions became the reason for choosing the research problem, which consists in the necessity of substantiating theoretical and practical aspects of using innovative mobile technologies, in particular mobile information applications and technologies in the formation and development of professional competencies of future teachers of mathematics, as well as the development of a methodological basis for the use of mobile applications and technologies to solve the problem.

Insufficient research of the problem of methodology of using mobile educational technologies in the process of teaching mathematical disciplines, in the preparation of professional competencies of future teachers of mathematics and the establishment of appropriate ways of solution determined the topic of the dissertation work «**Formation of professional competencies of future teachers of mathematics using mobile applications**».

In accordance with the set problem, the purpose, object and subject of the study were determined.

**Purpose of the study:** to develop a scientific and methodological approach to the use of innovative mobile technologies and applications for the formation of professional competencies of future teachers of mathematics.

**Object of the study:** the process of teaching mathematical disciplines in the system of higher pedagogical education on the basis of innovative mobile technologies and applications.

**Subject of the study:** scientific and methodological foundations of using mobile applications and technologies in the process of teaching mathematical disciplines for the development of professional competencies of future teachers of mathematics.

**Hypothesis of the dissertation research:** if to teach students to solve mathematical problems based on the use of mobile applications and technologies according to the developed approach, it is possible to provide an effective level of training of future teachers of mathematics, which contributes to the development of their professional competencies. In accordance with the purpose and hypothesis of the study, the following **tasks were defined:**

- To determine the theoretical and methodological basis for the use of mobile applications in the formation of professional competencies of future teachers of mathematics;

- To formulate criteria for evaluating the information competence of a future teacher of mathematics using mobile applications;
- To develop a scientifically and methodologically grounded approach to the use of mobile applications in the process of teaching mathematical disciplines;
- Experimentally test the effectiveness of the developed methodology of using mobile applications in the process of information competence formation.

**The leading idea of the study** is that if within the educational process of higher education institution, to use mobile technologies and applications not only as a means of demonstration of educational material, but also as a means of carrying out mathematical calculations and solving mathematical models from the field of mathematical analysis and differential equations, it contributes to the effective development of skills and abilities of future teachers of mathematics.

**Research methods:** analysis of domestic and foreign scientific works on pedagogy, psychology, mathematics and educational technologies; analysis of existing educational programs, textbooks, dissertation research, conference materials; generalization of experience in the use of mobile applications and technologies in the educational process; application of empirical methods of scientific knowledge, such as conversation, observation, conducting lectures and practical classes with students; pedagogical experiment and analysis of experimental activities.

**Theoretical and methodological basis of the study was formed by the following approaches:**

- general aspects of teaching mathematics in higher education (A.E. Abylkasymova, M.V. Egupova, S.M. Seitova, A.N. Nugusova);
- research of the structure of professional competencies of a teacher-mathematician (S.M. Seitova., G.B. Turtkaraeva, G.B. Akhmedieva, T.V. Richter, I.V. Kuznetsova, etc.);
- research of methodical training of future teachers of mathematics (B.N.Sydykov, A.A.Stolyar, S.M.Seitova, A.N.Nugusova, A.M.Mubarakov, O.S.Satybaldiev, E.A.Tuyakov, A.K.Kagazbaeva, etc.);
- research of pedagogical and psychological aspects of the use of innovative technologies in the educational process (Z.Dzalil, E.D.Bazhenova);
- methodology of developing teachers' information competencies through the use of modern educational technologies (Huang, Spector, Cheng, Fischer, etc.).

**Sources of research:** the Law of the Republic of Kazakhstan «On Education», the State Compulsory Standard of Higher Education, the Professional Standard «Teacher», the Address of the Head of State to the people of Kazakhstan, study of documents concerning the sphere of education, scientific works of domestic and foreign scientists in the field of pedagogy, psychology and mathematics, official materials of the Ministry of Science and Higher Education of the Republic of Kazakhstan, regulatory documents of the Republic of Kazakhstan, etc.

**Scientific novelty of the research** consists in the fact that it:

- Theoretical and methodical bases of using mobile applications in the formation of professional competencies of future teachers of mathematics are defined.
- Criteria for evaluating the information competence of future math teacher with the use of mobile applications and technologies are formulated
- The scientifically and methodologically grounded approach to the use of mobile applications in the process of teaching mathematical disciplines has been developed.
- The effectiveness of the developed methodology of using mobile applications in the process of information competence formation has been experimentally substantiated.

**Theoretical significance** consists in generalization of known theoretical bases of mobile applications application in the process of formation of professional competences of future teachers of mathematics and use in teaching of mathematical disciplines in higher education institution.

**The practical significance** lies in the use of the methodology of mobile applications in improving the professional training of future teachers of mathematics, which meets the key requirements of higher education.

**Reliability and validity** of the obtained results are proved by using systems of scientific methods of research, application of Mann-Whitney criterion for processing the obtained experimental results and presentation of the obtained results at scientific seminars of Zhetysu University named after Ilyas Zhansugurov, Institute of Mathematics and Mathematical Modeling and at international scientific-practical conferences.

**The following provisions are put forward for defense:**

1. Identified concepts of methodology concepts of using innovative educational technologies in teaching mathematics, which are the theoretical basis of the study;
2. Practical aspects of using mobile applications and technologies in the formation of professional competencies of future teachers of mathematics, which are the methodological basis of the study;
3. The developed methodology of using mobile information technologies in teaching mathematical disciplines, which enhances the professional training of future teachers of mathematics and meets the basic requirements of pedagogical education.

**Research base:** experimental research was conducted on the basis of Zhetysu University named after Ilyas Zhansugurov, secondary school №5 named after A.Zhubanov (Konaev), Taldykorgan Higher Polytechnic College, the Center for Professional Development and Complementary Education of Zhetysu University named after Ilyas Zhansugurov and Kazakh National Women's Pedagogical University.

**Stages of the study.** In accordance with the goals and objectives, the research work was conducted in three stages:

*At the first stage* (2019-2020) of the establishing experiment, the scientific and educational-methodological literature devoted to various aspects of the research problem was analyzed, which served as a basis for formulating the goal, objectives and hypothesis of the study. Psychological and pedagogical foundations of the implementation of educational technologies of orientation in the process of teaching mathematics at school and university were studied. The classification of educational technologies and their significance in the educational process is revealed.

*In the second stage* (2020-2021), the scientific and methodological model of using mobile educational technologies for solving mathematics problems in student learning was provided and specific recommendations for its use were formulated (exploratory experiment).

*At the third stage* (2019-2022), the scientific and methodological model of mobile technology application was tested, the effectiveness of its application was verified, the experimental and theoretical results obtained were processed and summarized, the results were formulated and the thesis work was formalized (forming experiment).

### **Approbation and introduction of the research into practice.**

The main conclusions of the dissertation research were reported and discussed at scientific seminars of the Higher school of natural science of Zhetysu University named after Ilyas Zhansugurov and during the scientific internship at the Institute of Mathematics and Mathematical Modeling of the Ministry of Education and Science of the Republic of Kazakhstan (Kazakhstan, Almaty).

The obtained research results were validated:

- in conducting professional development courses for mathematics teachers of secondary schools in Taldykorgan city and Almaty region in the period from January 27 to February 29, 2020 in cooperation with the Center for Professional Development and Complementary Education at Zhetysu University named after Ilyas Zhansugurov on the theme: «Development of professional competence of mathematics teacher in the conditions of updated content of education». The labor intensity of the courses amounted to 72 academic hours;
- at passing scientific internship in the Institute of Mathematics and Mathematical Modeling of Ministry of Education and Science of the Republic of Kazakhstan in the period from October 20, 2021 to November 20, 2021;
- on elective classes on mathematical modeling for the educational program on information and communication technologies of the Higher School of Technical Sciences of Zhetysu University named after Ilyas Zhansugurov;
- in the period from April 03 to April 29, 2023 together with Center for Professional Development and Complementary Education at Zhetysu University named after Ilyas Zhansugurov were organized and conducted professional development courses for teachers of mathematics of secondary schools of Taldykorgan city and Zhetysu region on the topic «Formation of

professional competencies of teachers of mathematics using mobile applications». The labor intensity of the courses amounted to 72 hours;

- experiment is implemented in the educational process, in the elective discipline «Applied packages in teaching mathematics» EP «6B01501-Mathematics» Kazakh National Women's Pedagogical University, Higher School of Mathematics, Physics and Digital Technologies, Department of Mathematics in the amount of 5 academic credits.

**Publications.** The main results and provisions of the dissertation research have been published in various scientific journals and collections, conference proceedings, a total of 13 papers, including:

- articles in the journals included in the list of peer-reviewed scientific publications, defined by the Committee for Quality Assurance in the field of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan-3;
- articles in the international peer-reviewed scientific journals, included in the Scopus database -2;
- articles in the scientific journals-4;
- articles in the proceedings of the international scientific-practical conference-2;
- textbook recommended by the Academic Council of the University-1;
- certificate of inclusion of information in the state register of rights to copyrighted objects-1.

**Structure and content of the thesis.** The dissertation consists of normative references, abbreviations, introduction, two chapters, conclusion, list of used literature and appendices.

*The introduction* formulates the relevance, scientific apparatus of the research problem: purpose, object, subject, scientific hypothesis of the research, tasks, theoretical and methodological foundations, stages and methods of research, research base, scientific novelty, theoretical significance, practical relevance and provisions for defense.

*The first chapter* deals with the structure of mathematical competencies and theoretical foundations of applying the concept of mobile learning in the course of mathematical disciplines of higher education institution. The review of works of foreign and domestic scientists dealing with these problems is given.

*The second chapter* formulates methodological requirements and presents a scientific and methodological model of mobile educational technologies application in the learning process in order to develop professional competencies. The implementation of the formulated requirements and the presented model in the form of a specific methodology aimed at the development of professional competencies is also considered. The methodology of organizing and conducting the pedagogical experiment is described, as well as its results are presented.

*The conclusion* of the thesis summarizes the results of the research and presents the main conclusions.

**List of used sources:** in the process of conducting the dissertation research was used sources consisting of 140 titles.

The appendix presents the material developed in the course of the research, not included in the thesis work and acts of implementation.