

## ANNOTATION

**dissertation work of Aizhan Kumarbekovna Koishybekova, on the topic «Scientific and methodological foundations of the organization of independent students in mathematical disciplines in higher educational institutions» submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D01501 — «Mathematics»**

### **Actuality of the study**

Currently, in modern universities, there is a need to improve the content, structure, and overall orientation of training future specialists in accordance with the requirements of the times. This is due to the fact that the problem of training a specialist who knows their profession, is capable of independent search, and has a high level of professional orientation has become the main requirement of modernity.

In his address to the people of Kazakhstan on September 1, 2021, titled "The Unity of the People and System Reforms Are a Solid Basis for the Country's Prosperity," the head of state, Kassym-Jomart Tokayev, noted: "In general, Kazakhstan's education and science face a large-scale, urgent task - to keep up with new trends, be one step ahead, and generate trends."

In the conditions of the new Kazakhstan, complex measures aimed at improving the quality of education, enhancing the national model of education, forming a pedagogical approach to new technologies, training competitive specialists, developing creative thinking in students, and fostering self-development and self-organization activities are necessary. To achieve this, it is necessary to increase the professional training of future teachers who will educate them.

Therefore, the main goal of modern higher education is to train a competent specialist who is competitive in the labor market, has developed competencies, can organize their activities, has their own vision directed toward productive work, can adapt optimally and quickly to changes, and can express their thoughts freely and creatively.

Based on the national project "Quality Education 'Educated Nation,'" one of the tasks approved by Resolution No. 726 of October 12, 2021, is "improving the quality of education for students at all levels of education." The main goal of vocational education is to prepare a competent, intelligent specialist worthy of the new society, who loves their profession and is able to answer any questions.

The *theory and practice of professional training of teachers* are discussed in the works of V.V. Kraevsky, V.A. Slastenin, N. Borytko, N.D. Khmel, Sh.T. Taubaeva, L.L. Sultanova, A.E. Abylkasymova, and G.Zh. Menlibekova. The problems of self-development and self-organization of students are reflected in the research of scientists U.M. Abdigapbarova, L. Suleimenova, A. Zakharova, L.V. Huzar, and others.

The study of the *credit education system* was carried out by V. Chistokhvalov, A. Chuchalin, A. Atykhanov, N. Asanov, S.A. Abdimanapov, S.B. Abdigapparova, Zh.D. Dadabaev, A. Kusainov, and other researchers who defined the basic concepts and provisions of this system and made a great contribution to the introduction of credit technology into the practice of higher education. The authors note that important aspects of this system are the rational use of educational time, the introduction of new pedagogical methods into the educational process, and the improvement of the level of learning. Particular attention is paid to the independent work of students, which is crucial in the formation of the professional competence of future specialists.

According to the authors, the independent work of students within the framework of the credit education system makes up two-thirds of the entire curriculum, and its effective organization directly affects the formation of professional training for future specialists. Effective organization of independent work serves as the basis for training specialists who are ready to compete in the global labor market and are able to engage in creative activities. Therefore, an important aspect is the effective organization of students' independent work in the credit education system, as well as the presence of unique and systematic approaches within this system.

In studies devoted to the problems of education in higher educational institutions, much attention is paid to the role of students' independent work as an integral element of higher professional education. Finnish researchers E. Kimonen and R. Nevalainen believe that independent work and active learning are the main forms of learning that provide the necessary competencies for modern individuals.

In psychological and pedagogical studies of the results of independent work and active learning, foreign scientists S. Vitvitska, P. Yakimenko, L. M. Rybalko, and others show that independence in the educational process contributes to the development of students' ability to take responsibility for their educational activities.

An analysis of the work of these researchers shows that certain types of technologies and methodologies can significantly improve the learning process today. However, these studies lack sufficient research into the problems of differentiation and individualization of the educational process, taking into account the natural perception of learning by each person and the need for a personalized approach.

Therefore, the university needs to introduce innovations into educational programs in accordance with international standards. Additionally, the education of comprehensively developed future specialists requires the creation of conditions for independent learning and the development of educational skills.

Many scientists consider the issues of training future *teachers and methods of teaching mathematical disciplines* in their research, including:

Russian and foreign scientists: N.V. Taimerbaeva, G.I. Sarantsev, Tatto M.T., M.S. Rodriguez, M. Recase, P.V. Gerasimenko, L.M. Fridman, M.V. Pototsky, V.A. Dalinger, Yu.M. Kolyagin;

Domestic scientists: B.B. Baimukhanov, A.E. Abylkasymova, A.K. Kagazbaeva, S.M. Seitova, B.R. Kaskataeva, O.S. Satybaldiev, A.N. Nugusova, D.N. Nurgabyly, E.Zh. Smagulov.

The problem of facilitating students' independent learning has attracted the attention of teachers, psychologists, and methodologists. Research related to methods of organizing and enhancing independent learning in education is examined in more detail.

The theoretical foundations of independent work in the educational process are set out in the works of the following scientists: P.I. Pidkasisty, B.I. Korotyaev, S.I. Arkhangelsky, Yu.K. Babansky, O.A. Nilson, L.S. Vygodsky, Y.G. Gendler, V.V. Kraevsky, V.A. Slastenin, V.I. Ermolaev, I.M. Vorotilkin, L.R. Ríos-Rodríguez (2021).

The organization of students' independent work from the perspective of higher education didactics is reflected in the works of: S.I. Arkhangelsky (1976), A.E. Abylkasymova (1994), M.V. Bulanova-Toporkova (2006), M.G. Garunova (1978), I.I. Kobylatsky (1972), G.I. Seitova (1988), Sh.T. Taubaeva (2015), A.S. Orynbekova (2019), A.K. Mynbaeva (2012), S.M. Seitova (2018), and others.

Over the past five years, there has been a recognized need at the state level to enhance the competencies of future specialists within the context of European integration in Kazakhstan's higher education system. Recent research by scientists suggests that organizing independent student work in specific university disciplines is crucial for developing modern professionals capable of engaging in professional activities. This is because the high-quality organization of independent student work has become a priority in managing the educational process at higher educational institutions, particularly in the context of distance education for specific disciplines.

Independent work should be organized not only under the guidance and direction of the teacher but also with the integration of the latest effective technologies. To ensure that today's students and tomorrow's specialists achieve a level of personal and professional orientation, it is essential to comprehensively study the types of independent work, the methods of their organization, the applied methodologies, the theoretical and practical aspects of their pedagogical outcomes, and the application of research results in practice.

The modern development of science and technology necessitates the improvement of students' skills in higher education, particularly in creative actions and independent knowledge acquisition, guided by general pedagogical principles. The degree of interaction between teacher-organizers and students has reached a completely new level. Consequently, teaching and learning methods have been transformed, leading to comprehensive changes in the structure and content of independent work as well as in the pedagogical and psychological objectives of its organization.

Despite the fact that the organization of independent work for students in the country's universities is widely covered, the problem of effectively organizing

independent work in the context of a changing educational paradigm due to the introduction of an innovative learning system has not been fully studied.

The requirements for the formation of personal and professional orientation of future mathematics specialists from higher education institutions, the state, society, and the increasing importance of students' independent work in the mathematics education system necessitate its effective organization.

However, there are contradictions between the insufficient number of specific scientific and methodological works on the effective organization of independent work in high-quality mathematics education, the lack of scientific justification for the pedagogical conditions of its organization, and the need for effective organization of independent work for future specialists in the credit system of education:

- between society's demand for the organization of independent work for students and the insufficient understanding of the problem of preparing future teachers to manage it;
- the lack of differentiation in the goals and structure of conducting independent work and the requirements of credit technology in the process of organizing students' independent work;
- the lack of comprehensive creation of pedagogical conditions for students' independent work, oriented towards achieving results at the university.

The contradictions under consideration and their insufficient study in theory and practice contributed to the choice of the topic: "Scientific and Methodological Foundations for the Organization of Independent Work in Mathematical Disciplines at the University."

**Purpose of the Study:** To provide a theoretical and methodological justification for improving the organization of independent work in mathematical disciplines at the university in accordance with societal requirements.

**Object of the Research:** The process of teaching mathematical disciplines at a university.

**Subject of the Study:** Improving the organization of independent work in mathematical disciplines at the university.

**Research Hypothesis:** If the organization of independent work in mathematical disciplines at the university is improved in accordance with societal requirements, and its implementation is methodically justified and integrated into the educational process, then we can ensure a sufficient theoretical and methodological level of education. This is because independent work contributes to improving the quality of students' knowledge.

**Objectives of the Research Work:**

- Identification of psychological and pedagogical aspects of organizing independent work in higher educational institutions.
- Defining the features and requirements for organizing independent work of students at the university.
- Creating a model for organizing independent work aimed at developing students' activity and independence.
- Development of a methodological system for evaluating and organizing independent work in mathematical disciplines.
- Experimental verification of the implementation of a methodological system for organizing and evaluating independent work in mathematical disciplines.

**To achieve the goal and solve the tasks set, the following research methods were used:**

- General scientific methods of theoretical research: collection and analysis of theoretical material, and study of methodological literature on the problem of organizing independent work of students in the process of teaching mathematical disciplines at a university, classification, and generalization of the results obtained.
- Methods of sociological research: participation in classes of mathematics teachers, oral and written conversations with teachers, students, and undergraduates, questionnaires, and testing.
- Empirical research methods: conducting a pedagogical experiment to confirm the hypothesis of the study, analyzing and processing the results of the experiment using statistical research methods.

### **Theoretical and Methodological Foundations of the Study:**

Scientists from far and near abroad, such as Yu.K. Babansky, I. Ya. Lerner, P.I. Pidkasistoy, L. V. Usova, and others, have studied in detail the types of independent work.

The peculiarities of the organization of independent work of students in universities were considered by G. Akhmetova, N. Asanov, A. K. Sadykova, and K. L. Goncharova.

The works of A.E. Abylkasymova, N.A. Adelbaeva, S.I. Arkhangelsky, M. V. Bulanova-Toporkova, M. G. Garunov, I. I. Kobylatsky, and R. A. Nizamov are devoted to the disclosure of the essence of the organization of independent work of students from the point of view of didactics of higher education.

The need for the systematic use of independent work in the educational process, its effectiveness, and aspects of the systematic method have been studied by U. Abdukarimova, V.K. Buryak, T.T. Galiev, E.Ya. Golant, K. Duisenbayev, B.P. Esipov, R. M. Mikelson, E.S. Sablik, M.N. Skatkina, and others.

**Research Sources:** The Law of the Republic of Kazakhstan «On Education», the State Mandatory Standard of Higher Education, the Professional Standard "Teacher",

the Message of the Head of State to the People of Kazakhstan, the conceptual basis of education in the context of the implementation of the program «Rukhani Zhangyru», documents related to the field of education, as well as the works of philosophers, psychologists, mathematicians, and teachers concerning research topics, standard curricula, textbooks, teaching aids, and the latest scientific and methodological practices.

**Scientific Novelty of the Research:**

The psychological and pedagogical aspects of the organization of independent work in higher educational institutions are substantiated.

The features of the organization and requirements for independent work of students at the university are revealed.

A model for organizing independent work aimed at developing students' activity and independence has been created.

A methodological system for organizing and evaluating independent work in mathematical disciplines has been developed.

**Theoretical Significance of the Research Results:** Improving the organization of justified independent work of university students to enhance the quality of education should meet societal needs and comply with the basic requirements of higher pedagogical education in the study of mathematical disciplines.

**Practical Significance of the Research:** The dissertation research contains material that can be used by undergraduates and doctoral students in the preparation of educational programs "Mathematics" and "Mathematics and Computer Science" in the direction "6B015 - Teacher Training in Natural Sciences". The dissertation examines the problems, main processes, and features of students' independent work organized in the study of mathematical disciplines that meet modern requirements. The proposed model for organizing independent work aimed at developing the activity and independence of students can provide methodological assistance to undergraduates, doctoral students, and young teachers of mathematical disciplines.

**Accuracy and Validity of the Research Results:** The accuracy and validity of the research results are ensured by the analysis of scientific and educational literature on the problem under study; the use of a set of scientific research methods, a rational combination of theoretical and experimental approaches; and the use of mathematical processing of statistical methods confirming the results of the experimental study.

**Principles to be Defended:**

The theoretical basis of the research will be the psychological and pedagogical aspects of organizing independent work in universities.

The peculiarities of organizing independent work of students at the university and the associated requirements can serve as a methodological basis for research.

A methodological system for organizing and evaluating students' independent work in mathematical disciplines that meets the basic requirements of pedagogical education.

**Research Base:** The experimental study was conducted at I. Zhansugurov Zhetisu University, the Kazakh National Women's Pedagogical University, and the Center for Advanced Training at I. Zhansugurov ZHU.

**Main Stages of the Study:** The main stages of the study, corresponding to the goals and objectives, were divided into three periods from 2020 to 2024. The experimental activity was carried out within the educational process and included the following stages:

1. **At the first stage (2020-2021)**, an analysis of educational and methodological literature on various aspects of the problem was conducted. The organization of students' independent work in the study of mathematical disciplines at the university was analyzed. The data obtained from the theoretical analysis and literature review served as the basis for determining the purpose and objectives of the study, as well as making a forecast of the work.

2. **At the second stage (2021-2022)**, a methodological system for organizing and evaluating students' independent work in mathematical disciplines and a model aimed at developing students' activity and independence were developed.

3. **At the third stage (2022-2023)**, theoretical issues of the study were clarified, and an experiment was conducted. During the experiment, the methodological system for organizing and evaluating students' independent work in mathematical disciplines was tested. The obtained theoretical and experimental results were processed, generalized, their effectiveness was proved, and the system was implemented into the learning process.

#### **Approval and Implementation of Research Results into Practice:**

The main provisions and results of the study were presented and discussed at scientific and methodological seminars of the educational program "Mathematics and Physics" at ZhSU named after I. Zhansugurov. They were also included in the textbook "Methods of Organizing Independent Work of Students in Mathematical Disciplines." Additionally, the study results were presented at the Department of Mathematics of the Institute of Physics, Mathematics, and Digital Technologies of the Kazakh National Women's Pedagogical University (Almaty, Kazakhstan) during a scientific internship.

From May 2 to May 13, 2023, in collaboration with the Center for Advanced Training and Additional Education at ZhSU named after I. Zhansugurov, a refresher course for mathematics teachers of secondary schools in Taldykorgan and Almaty region was organized and conducted on the topic: "The Application of the Project Method in the Organization of Independent Work in Mathematical Subjects" (36 academic hours).

**Publications:** The main content of the dissertation was published jointly with domestic and foreign scientific consultants in publications recommended by the Committee for Quality Assurance in the Field of Science and Education of the Ministry of Education and Science of the Republic of Kazakhstan, and in materials of international scientific and practical conferences, totaling 14 scientific papers.

Scientific articles published in SCOPUS - 1 (percentile-79, quartile-Q1).

Scientific articles published in journals recommended by the Committee for Quality Assurance in the Field of Science and Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan - 3.

Scientific articles published in the materials of international scientific and practical conferences - 4.

Scientific articles published in foreign peer-reviewed journals - 3.

Textbook recommended by the Academic Council of the University - 1.

Certificate of entry of information into the state register of objects protected by copyright - 1.

The scientific results of the dissertation research are reflected in the following publications:

**The Structure and Content of the Dissertation:** The dissertation consists of normative references, definitions, abbreviations, an introduction, three sections, a conclusion, a list of references, and appendices.

*The introduction discusses the purpose, object, and subject of the research, scientific forecast, tasks, theoretical and methodological foundations, stages and methods of research, research base, scientific novelty, theoretical and practical significance, principles proposed for defense, and the validity and accuracy of the research results.*

*In the first section, "Theoretical Foundations of the Organization of Independent Work of Students at the University," the following topics are defined:*

The essence of independent work and its place in the student's personal development.

Psychological and pedagogical aspects of the organization of independent work in universities.

Features of the organization of independent work of students at the university.

*In the second section, "Methods of Organizing Independent Work in Mathematical Disciplines in Universities," the following topics are presented:*

Requirements and pedagogical conditions for the organization of independent work in mathematical disciplines at the university.

Criteria for evaluating the components of independent work in mathematical disciplines.

Methodological system for organizing and evaluating independent work in mathematical disciplines.

*In the third section, "Substantiation of the Effectiveness of the Organization of Independent Work of Students in Mathematical Disciplines," the following topics are covered:*

Determination of the relationship between the levels of independent work and students' academic performance in mathematical disciplines.

Statistical processing of the results of the study of the effectiveness of methods of organizing independent work.



*In conclusion*, the main results of the dissertation research are formulated, along with conclusions and recommendations for their further use in research in the field of pedagogy and teaching mathematics, and the prospect of further study.

During the dissertation research, literature consisting of 150 titles was used. The appendix contains materials developed during the research.

The acts of introducing research results into the educational process at I. Zhansugurov Zhetysu University, Kazakh National Women's Pedagogical University, and the Center for Advanced Training at I. Zhansugurov Zhetysu University are presented.