

## ANNOTATION

### to the dissertation of Elmira Saparbayeva for the degree of Doctor of Philosophy (PhD) in the educational programme 8D01510 – Mathematics

**Research topic:** Methods for implementing professionally oriented teaching of mathematics to students of the «Construction» direction in higher education institutions

**Research Goal:** Determination of the theoretical foundations of professionally-oriented mathematics training for students in the «Construction» field at higher educational institutions, development of a corresponding methodology, and verification of its effectiveness by a pedagogical experiment.

#### **Research Tasks:**

1. Reveal the essence of the concept of «professionally oriented training», determine the modern state of mathematical preparation for future specialists in the construction industry in higher educational institutions;
2. Justify the goal and content of professionally-oriented mathematics training for students in the «Construction» field, as well as its connection with general and special technical disciplines;
3. Develop a methodology for professionally-oriented mathematics training for students in the «Construction» field;
4. Experimentally verify the effectiveness of the methodology for professionally-oriented mathematics training for students in the «Construction» field and analyze the results.

#### **Research Methods:**

- retrospective analysis: conducting an analysis of the Law of the Republic of Kazakhstan «On Education», state compulsory standards of higher and postgraduate education, and educational programs in the «Construction» field;

- theoretical analysis: study of dissertation research, scientific-methodological and educational-methodological literature, and scientific articles on the research topic;

- empirical methods: surveying mathematics teachers and students in the «Construction» field, as well as conducting control works;

- pedagogical experiment, diagnostic methods, and mathematical-statistical processing of results.

#### **Key points for the defense:**

1. Professionally-oriented mathematics training for students in the «Construction» field at higher educational institutions is an important condition for the formation of their professional competence.
2. The proposed content and methodology of professionally-oriented mathematics training for future construction specialists increase the efficiency of the educational process and form practical skills adapted to professional activity.
3. The pedagogical experiment showed the effectiveness of the methodology for improving the mathematical preparation of students through professionally-oriented and applied tasks in practical classes.

## **Description of the main research results**

The relevance of the work is determined by the need to form the professional competence of specialists in higher technical education, especially in the «Construction» field, at the current stage.

Mathematics training for students in the «Construction» field should not only maintain its role as a fundamental subject but also have a professionally-oriented character.

In this context, during the research, a methodology for professionally-oriented mathematics training for students in the construction field was developed, and its effectiveness was verified through a pedagogical experiment.

Based on the analysis of pedagogical, psychological, and methodological literature, professionally-oriented training was considered as a holistic pedagogical system of content, methods, and forms of education aimed at the professional activity of the future specialist.

Analyzing the definitions of professional training given by domestic and foreign educators, we decided to give the following definition: «Professionally-oriented training is a pedagogical process based on the principle of professionalism in teaching, ensuring increased interest in the student's future activity, the combination of theoretical knowledge with practice, and the development of professional thinking».

It includes increasing student interest in their future career, combining theoretical knowledge with practice, and developing professional thinking.

The interdisciplinary connection of the content of mathematics training with general and specialized technical disciplines related to the construction industry was determined.

On this basis, the content of the principles of continuity, sequence, consistency, scientific nature, professionalism, interdisciplinary connection, applied orientation, motivation, and personal orientation was clarified, and their role in the preparation of future construction students was revealed.

The effectiveness of selecting mathematics teaching content adapted to the specifics of the training field, using active teaching methods, and digital technologies was demonstrated.

The structure and content of professionally-oriented mathematics training for construction students were systematized.

The content of mathematics training was divided into general theoretical, professional, and applied components, and their interdisciplinary connection was integrated with general professional and specialized disciplines related to the construction industry.

A methodological system for professionally-oriented mathematics training for construction students was developed. The system consists of target, content, and procedural components.

The effectiveness of the methodological system is evaluated based on the results of the mathematical education of future specialists in the construction field. It allows determining the level of mastery of professionally important mathematical knowledge, skills, abilities, and methods for solving engineering problems by future

construction specialists, measuring students' emotional-value attitude towards mathematics and mathematical activity, as well as the results reflected in their actions, using specially developed assessment criteria.

The system demonstrates innovative methods of organizing the educational process (project, problem, research methods), forms (lecture, seminar, practice); ways of using digital tools and systems of applied tasks. The methodology is aimed at developing students' professional engineering thinking, logical analysis, and modeling skills.

A methodology for improving the mathematical preparation of students was presented in practical classes.

Solving professionally-oriented mathematical problems, modeling real engineering situations, and measurement and calculation tasks allowed students to transform their theoretical knowledge into practical skills.

The results of the pedagogical experimental work confirmed the effectiveness of the proposed methodology. As a result of implementing the research results into the educational process, the semester and final exam results of the experimental group of students were significantly higher than those of the control group.

The quality of mathematical knowledge, the level of performance of practical tasks, and professional motivation indicators increased.

#### **Scientific novelty of the research:**

1. The essence of the concept of «professionally-oriented training» for students in higher educational institutions was revealed, and the place and modern state of professionally-oriented mathematics training for future construction specialists were determined.
2. The goal and content of teaching mathematics to future construction students, didactic principles, as well as the connection of mathematics with general technical and special technical disciplines and professional skills were determined.
3. A methodology for professionally-oriented mathematics training for students in construction fields was developed, and a system of professionally-oriented tasks was developed, allowing for the implementation of this methodology; methods for teaching the solution of professionally-oriented tasks in practical classes and possibilities for using digital technologies were proposed.
4. The methodology for professionally-oriented mathematics training for students in the «Construction» field was experimentally verified and its effectiveness was proven.

**Compliance with the directions of science development or state programs:** the dissertation topic is characterized by the main directions specified in the Law of the Republic of Kazakhstan «On Education», in the Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023–2029, as well as in the state compulsory standards of higher and postgraduate education.

**Methodological foundations of the research work:** didactic foundations of higher education, higher technical education, professionally-oriented training, activity and competency-based approaches in teaching, research works on the content of professional education and the theory of knowledge, the concept of

mathematical education, theory and methodology of teaching mathematics, theory of forming the professional competence of future construction specialists; works in the field of teaching the solution of professionally-oriented mathematical problems.

**Theoretical foundations of the research work:** psychological-pedagogical, scientific-methodological, and educational-methodological works on the topic and problem of the research; professionally-oriented training, continuity of the content of mathematical education and its connection with special disciplines, systematic-activity and competency-based approaches; the concept of mathematical education; theoretical and methodological foundations of teaching mathematics for technical specialties in higher educational institutions.

**Research sources:** the Law of the Republic of Kazakhstan «On Education» was studied; the Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023-2029, state compulsory standards of higher and postgraduate education, the educational program «6B07320 - Construction», syllabus and educational-methodological complexes of the disciplines «Mathematics-1» and «Mathematics-2», theory and practice of professionally-oriented mathematics training, dissertation research, and scientific-methodological works.

**Theoretical significance of the research:** In the dissertation, the theoretical foundations, goal, and content of professionally-oriented mathematics training for construction students in higher educational institutions, its connection with general professional and special technical disciplines, as well as professional skills were determined; teaching methods, organizational forms, and digital educational resources aimed at improving the mathematical preparation of future construction specialists were proposed.

Methods of problem-based and project-based learning, the methodology for teaching the solution of professionally-oriented tasks in practical classes, and ways of applying digital technologies in organizing professionally-oriented mathematics training for students in the «Construction» field were shown.

**Practical significance of the research:** The methodological system of professionally-oriented mathematics training for students studying under the educational program «6B07320 - Construction» presented in the dissertation, and its content and procedural (activity) components, namely: the goal and content of professionally-oriented mathematics training, methods and forms of teaching, methodological recommendations for using digital technologies, professionally-oriented mathematical tasks and the methodology for solving them, can be used to improve the professional and mathematical preparation of students.

The research results contribute to the improvement of the methodological foundations of teaching mathematics adapted for technical specialties in higher educational institutions.

A textbook on the discipline «Mathematics» for students of the educational program 6B07305-«Construction» was developed and implemented into the educational process (Shymkent: M. Auezov South Kazakhstan University, 2024. - 240 p.).

**Publication of results obtained during the execution of the dissertation.**

**The doctoral student's contribution to the preparation of each publication (the contribution of the author of the dissertation to the total volume of the publication is indicated as a percentage):**

The total number of published works on the content of the dissertation is 10, including 2 in journals included in the Scopus database, 2 in scientific publications recommended by the Science and Higher Education Quality Assurance Committee of Ministry of Science and Higher Education of the Republic of Kazakhstan, 5 at international scientific-practical conferences, and 1 textbook.

All publications were prepared during the research.

1. «Leveraging digital tools to advance mathematics competencies among construction students». // Cogent Education 2024, VOL. 11, NO. 1, 2319436 (**62-процентиль**), SCOPUS. (co-authors: Abdualiyeva M.A., Torebek E.Zh., Madiyarov N.K., Tursynbayev A., doctoral student's share - 80%).
2. «Transforming mathematics education in Kazakhstan: evaluating the impact of innovative teaching methods on student outcomes in technical universities» // Cogent Education 2025, VOL. 12, NO. 1, 2461978 (**62-процентиль**), SCOPUS. (co-authors: Abdualiyeva M.A., Torebek E.Zh., Tursynbayev A., Takibayeva G.A., Sabalakhova A.P., doctoral student's share - 70%).
3. «Methodological model of teaching mathematics based on the formation of project activities for students of the «Construction» field». // scientific journal of Toraighyrov University, Bulletin of Toraighyrov University, pedagogical series, recommended by KOKSON MNVO RK. №3, 2022, pp. 81-95. (co-authors: Abdualiyeva M.A., Torebek E.Zh., doctoral student's share - 80%).
- 4.«Pedagogical foundations of using the project method in forming the research activity of future builders» // Bulletin of Zhetysu University named after I. Zhansugurov, «Pedagogical Sciences» series, recommended by KOKSON MNVO RK. №1(118), 2026, pp. 272–284 (co-authors: Abdualiyeva M.A., Altynbekov Sh.E. Zh.N., doctoral student's share - 80%).
5. «Methodology for implementing professional training when teaching mathematics to students in the «Construction» field based on project-technological activity» // Proceedings of the X International Scientific Conference «Mathematics and Mathematical Education» «Mathematics. Education. Culture» (to the 160th anniversary of the birth of David Hilbert). Tolyatti: Tolyatti State University, 2022. pp. 193-196. (co-authors: Abdualiyeva M.A., doctoral student's share - 90%).
6. Theoretical and Methodological Aspects of New Educational Technologies in Higher Education // Proceedings of the International Scientific and Practical Conference "Auezov Readings–20: Mukhtar Auezov's Heritage - The Nation's Wealth," dedicated to the 125th anniversary of M.O. Auezov. Shymkent: M. Auezov South Kazakhstan University. 2022. pp. 31-36. (Co-authors: Zhunisbekova D., Utenov N.M.; doctoral student's share - 90%).
7. The Motion of a Material Point in a Non-Central Gravitational Field // Proceedings of the International Scientific and Practical Conference "Auezov Readings - 22: Academician Kanysh Satpayev - The Founder of Kazakhstani Science," dedicated to the 125th anniversary of Academician Kanysh Satpayev. Shymkent: M. Auezov South Kazakhstan University. 2024. Vol. 9, pp. 167-170.

(Co-authors: Nurseitov K.S., Adishova G.B., Dzhumagalieva A.; doctoral student's share - 70%).

8. Conceptual Framework for Developing a System of Tasks to Form Research Skills in High School Students // Materials of the International Scientific and Practical Conference "Digitalization of Education: Artificial Intelligence and the Development of Science," dedicated to the memory of Doctor of Pedagogical Sciences, Professor Burkit Baimukhanov. Taldykorgan: Zhetysu University named after I. Zhansugurov. 2025. pp. 207-211. (Co-authors: Myrzabekov T.M., Duysebaeva P.S., Beisebaeva A.; doctoral student's share - 80%).

9. The Significance of Mathematical Knowledge in the Professional Training of Future Builders // Eurasian Education, Science and Innovation Journal. Volume 10. Aachen, 2022. pp. 108-112.

10. Study Guide "Mathematics" for the Educational Program Group "Urban Planning, Construction Works, and Civil Engineering" — Shymkent: M. Auezov South Kazakhstan University, 2024, 240 p. (Co-authors: Sabalakhova A.P., Altynbekov Sh.E.; doctoral student's share — 80%)