

ANNOTATION

**to the dissertation of Alibekova Zhazira for the degree
of Doctor of Philosophy (PhD) in the educational programme
8D01510 – Mathematics**

Research topic: Teaching students of specialized classes solving problems with practical content using the method of mathematical modeling

Purpose of the study: theoretical justification for teaching students in specialized classes to solve problems with practical content using mathematical modeling and the development of appropriate methods.

Research objectives:

- Analysis of the current state of teaching problem solving with practical content in specialized classes in secondary education system within the framework of the course "Algebra and initial of Analysis";
- Determining the potential for using mathematical modeling in solving problems with practical content in the school mathematics curriculum;
- Identifying the didactic foundations for teaching high school students to solve problems with practical content using mathematical modeling;
- Developing a methodology for teaching 11th-grade students in the natural sciences and mathematics program to solve problems with practical content using mathematical modeling and demonstrating its effectiveness through a pedagogical experiment.

Research methods:

- Theoretical analysis: study and analysis of pedagogical, mathematical, and scientific-methodological literature to determine the theoretical and methodological foundations of the study;
- Empirical methods: experimental work with students and teachers, observation, questionnaires, and interviews;
- Statistical analysis: statistical processing and analysis of student learning outcomes and experimental data.

The main provisions (proven scientific hypotheses and other conclusions that are new knowledge) submitted for defense

1. The theoretical principles and didactic principles for teaching practical problem solving using mathematical modeling in specialized classes form the theoretical basis of the study.
2. A system of practical problems for specialized classes in the natural sciences and mathematics and methods for solving them using mathematical modeling are proposed as the methodological basis of the study.
3. The elective course "Solving Practical Problems Using Mathematical Modeling," its content, and teaching methods characterize the methodological framework of the study.
4. The results of the pedagogical experiment confirm the effectiveness of the proposed methodology, and the developed teaching recommendations meet the

requirements of specialized education and contribute to the improvement of mathematics teaching in schools.

Description of the main research results

An analysis of psychological, pedagogical, scientific, and methodological literature and conducted research resulted in the definition of the concepts of a problem with practical content and mathematical modeling, the potential for using mathematical modeling in solving problems with practical content, and the identification of key requirements for the conditions of such problems and their mathematical content. An analysis of the current state of teaching practical problem solving in mathematics in specialized classes was conducted.

Based on an analysis of research by domestic and international scholars, the substantive, activity-based, and reflective components of teaching students in specialized classes to solve practical problems using mathematical modeling, as well as their indicators and criteria, were identified.

To provide methodological preparation for the effective application of mathematical modeling in solving problems with practical content in the "Algebra and Elements of Analysis" course for specialized classes in the natural sciences and mathematics field, the following didactic conditions were identified:

- development of the content of practice-oriented problems aimed at developing mathematical skills;
- Implementation of a student-centered approach to solving practice-oriented problems;
- Use of digital educational resources to solve problems with practical content using mathematical modeling;
- Ensuring interdisciplinary connections and linking problems with real-life situations when solving problems with practical content.

A methodological framework for teaching practical problem solving using mathematical modeling in the "Algebra and Elements of Analysis" course for specialized classes in the natural sciences and mathematics program was developed. Furthermore, the content of the elective course "Solving Practical Problems Using Mathematical Modeling" was developed, the forms, methods, and tools for teaching it were determined, and the proposed methodology was implemented into the educational process.

Based on the developed learning components and student proficiency criteria for the natural sciences and mathematics program, the effectiveness of the proposed methodology for teaching practical problem solving using mathematical modeling in the "Algebra and Elements of Analysis" course was experimentally proven. The results of the pedagogical experiment were processed using mathematical statistics, confirming its effectiveness.

Justification of the novelty and importance of the obtained results:

- The need for teaching practical problem solving in mathematics in specialized classes was substantiated;
- The potential for using mathematical modeling in solving practical problems in the school mathematics curriculum was identified, and didactic principles and

conditions for teaching high school students to solve such problems were identified;

- A system of practical problems for specialized classes in the natural sciences and mathematics was developed, and solutions using mathematical modeling were presented;

- An elective course for 11th-grade students in the natural sciences and mathematics program was developed, aimed at teaching practical problem solving using mathematical modeling, and a teaching methodology was developed.

Compliance with the directions of scientific development or state programs:

This research paper is guided by the objectives outlined in the Law of the Republic of Kazakhstan "On Education" and the Concept for the Development of Preschool, Secondary, Technical, and Vocational Education in the Republic of Kazakhstan for 2023–2029, approved by Decree No. 249 of the Government of the Republic of Kazakhstan dated March 28, 2023.

Zh.D. Alibekova's dissertation is in line with the "Research in Education and Science" program approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan.

Description of the doctoral student's contribution to the preparation of each publication:

1. Teaching Learners of Specialized Classes the Method of Mathematical Modeling based on Solving Problems with Practical Content // Qubahan academic journal. 2024, vol 4, No 3, pages 823-831. SCOPUS, Education. (Co-authors: Ashirbayev N.K., Ashirbayev Zh.N., Altynbekov Sh.Y, the share of doctoral students is - 80%).

2. Developing students' mathematical thinking skills through the use of mathematical modeling// "Bulletin of Yasawi University".– 2022. – No4 (126). – P. 212–224. (Co-authors: Meirbekova G.P., Koshanova G.D., the share of doctoral students is - 70%).

3. Mathematical modeling method in teaching students to solve applied problems in high school // "Bulletin of Yasawi University". – 2023. – No4 (130). – P. 329–343. (Co-authors: Ashirbayev N.K., Meirbekova G.P., the share of doctoral students is - 80%).

4. Role and place of use of mathematical modeling in specialized classes// 3i: intellect, idea, innovation. - 2025. - No 1 . – Б. 258–263. (Co-authors: Ashirbayev N.K., Myrzabekov T.M., Ashirbayeva Zh.N., the share of doctoral students is - 85%).

5. The approach to teaching the topic "Production" is based on the method of mathematical modeling // Proceedings of the X International Scientific Conference "Mathematics. Education. culture" (David Gilbert's 160th birthday), Russia, Togliatti, 2022 y. (Co-authors: Ashirbayev N.K., the share of doctoral students is - 90%).

6. The use of mathematical modeling in the school mathematics course // Proceedings of the international scientific and practical conference "Auezov Readings - 19: 30 Years of Independence of Kazakhstan". - Shymkent, - 2021. -

P.181-185. (Co-authors: Ashirbayev N.K., the share of doctoral students is - 90%).

7. Using exponential and logarithmic functions in solving practical problems// Proceedings of the international scientific and practical conference "Auezov Readings - 19: 30 Years of Independence of Kazakhstan". - Shymkent, - 2021.- P. 185-189. (Co-authors: Ashirbayev N.K., the share of doctoral students is - 90%).

8. Functions and goals of teaching mathematical modeling at school // Proceedings of the international scientific and practical conference "Auezov Readings – 20: The legacy of Mukhtar Auezov is the legacy of the nation" devoted to the 125th anniversary of M. O. Auezov. – Shymkent,-2022.- P. 199-203. (Co-authors: Ashirbayev N.K., the share of doctoral students - 90%).

9. Methodological foundations of teaching the concept of "mathematical model" in the school mathematics course // Proceedings of the international scientific and practical conference "Auezov Readings – 21: New Kazakhstan - future countries" devoted to the 80th anniversary of the M.Auezov South Kazakhstan University – Shymkent,-2023.- P. 106-110. (Co-authors: Ashirbayev N.K., the share of doctoral students - 90%).

10. «Teaching elementary school students to solve practical problems using mathematical modeling» Educational and methodological manual. – Shymkent: M.Auezov South Kazakhstan University, 2023. –80p. (Co-authors: Ashirbayev N.K., the share of doctoral students 80 %).