ABSTRACT

of the dissertation on the topic
«Methodology of teaching discrete elements of mathematics in the preparation of future computer science teachers in the context of digital education»
for the degree of Doctor of Philosophy (PhD)
in the educational program 8D01502-Computer Science
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Research topic: Methodology of teaching discrete elements of mathematics in the preparation of future computer science teachers in the context of digital education

Research goal: Development of a Methodology for Teaching Elements of Discrete Mathematics in the Training of Future Computer Science Teachers in the Context of Digital Education

Research objectives:

- theoretical analysis of domestic and international experience in integrated teaching of elements of discrete mathematics in the context of digital education;
- analysis of the current state of teaching discrete mathematics in the training of future computer science teachers and justification of the need for integrated instruction;
- development of a teaching model for discrete mathematics elements using digital technologies in the training of future computer science teachers;
- definition of the goals and content of integrated instruction in discrete mathematics elements for future computer science teachers;
- development of teaching tools, a digital educational resource, and a methodology for teaching elements of discrete mathematics within core disciplines in the training of future computer science teachers, along with analysis of the results of a pedagogical experiment.

Research methods. Analysis and study of theoretical and methodological research, as well as literature on the research topic; conducting pedagogical monitoring and surveying participants of the educational process (university teachers and students); conducting a pedagogical experiment to determine the effectiveness of the teaching methodology; methods for analyzing results and data.

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

1. In the context of digital education, the integrated teaching of elements of discrete mathematics to future computer science teachers within the content of core disciplines in the computer science curriculum contributes to enhancing the effectiveness of specialist training, positively influencing the quality of teaching core subjects.

2. The model of integrating elements of discrete mathematics into the content of core computer science disciplines in the training of future teachers in the context of digital education improves the methodological level and professional preparation of future specialists.

3. The use of the textbook “Elements of Discrete Mathematics in Computer Science Education” and the digital educational resource “Discrete Mathematical Approaches in Teaching Computer Science”, aligned with the defined goals and content of integrated instruction, contributes to the effective acquisition of educational material by students within the core disciplines of the computer science curriculum.

4. The proposed methodology for training future computer science teachers in the context of digital education, including the described approach to integrating elements of discrete mathematics into the content of core disciplines, enables the preparation of educators capable of applying active teaching methods in a digital educational environment. These educators will be well-versed in fundamental concepts and professionally competitive, in accordance with the dynamic development of the modern IT industry.

Description of the main results of the study:

- the current state and the necessity of integrated instruction in elements of discrete mathematics in the training of future computer science teachers have been substantiated;
- a teaching model for elements of discrete mathematics using digital technologies in the training of future computer science teachers has been developed;
- the goals and content of integrated instruction in elements of discrete mathematics for the training of future computer science teachers have been defined;
- a teaching tool integrating elements of discrete mathematics into the content of core disciplines, a digital educational resource, and a teaching methodology have been developed for the training of future computer science teachers.

Substantiation of the novelty and significance of the results obtained:

The first result is new, the study substantiates the necessity of teaching elements of discrete mathematics within the content of core computer science disciplines as an innovative approach to education in the context of digital learning. It has been established that this integration contributes to improving the effectiveness and quality of instruction.

The second result is new, a teaching model for elements of discrete mathematics has been developed for training future computer science teachers in the context of digital education. This model combines theoretical knowledge with practical application, fosters digital literacy, and enhances instructional methodology. It represents a significant contribution to the preparation of teaching staff adapted to the demands of a competitive digital transformation.

The third result is new, the goals and content of integrating elements of discrete mathematics into the core disciplines of the computer science educational program have been defined. This deepens the content of these disciplines and expands opportunities for developing the professional competencies of future teachers.

The fourth result is new, a teaching methodology has been developed for the integrated instruction of elements of discrete mathematics within the content of core disciplines, incorporating a digital educational resource and teaching tools. The methodology emphasizes the alignment of content and tools, practical orientation,

accessibility and clarity, and the development of future teachers' professional competencies.

Compliance with the directions of scientific development or government programs. Concept for the Development of Artificial Intelligence for 2024–2029 (Decree of the Government of the Republic of Kazakhstan dated July 24, 2024, No. 592), Concept for the Development of Preschool, Secondary, Technical and Vocational Education in the Republic of Kazakhstan for 2023–2029 (Decree of the Government of the Republic of Kazakhstan dated March 28, 2023, No. 249), Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023–2029 (Decree of the Government of the Republic of Kazakhstan dated March 28, 2023, No. 248), On the Approval of State Compulsory Standards of Higher and Postgraduate Education (Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022, No. 2), On the Approval of Model Curricula for General Education Subjects and Elective Courses for Primary, Basic Secondary, and General Secondary Education Levels (Order of the Minister of Education of the Republic of Kazakhstan dated September 16, 2022, No. 399).

Description of the contribution (the share must be at least 65 percent) of the doctoral student in the preparation of each publication.

The main conclusions, as well as the theoretical and practical results of the research, have been presented at international and national conferences: the International Scientific and Practical Conference «Modern Trends in Teacher Education» (Taraz, 2019), the International Scientific and Practical Conference «Physics and Mathematics Education: Goals, Achievements, and Prospects» (Minsk, 2021), the International Scientific and Practical Conference «Digital Transformation in the Learning Process and Applied Software» (Kyzylorda, 2022), the VII World Congress of Mathematicians of the Turkic World (Turkestan, 2023), and have also been discussed at the scientific-methodological seminars of the Department of Informatics, Institute of Physics, Mathematics and Digital Technologies of the Kazakh National Women's Teacher Training University.

In total, eight publications have been produced on the topic of the dissertation, including: 1 article in a peer-reviewed journal with an impact factor indexed in the Scopus database – Journal of Information Technology Education: Innovations in Practice (Q2, Perc. 70%), 3 articles in journals included in the list of the Committee for Quality Assurance in the Sphere of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, 4 articles in the proceedings of international and national scientific-practical conferences, 1 textbook, 1 certificate of authorship for a computer software program.

Publications:

1. Unveiling The Digital Equation Through Innovative Approaches For Teaching Discrete Mathematics To Future Computer Science Educators. // Journal of Information Technology Education: Innovations in Practice. – 2023. – Vol. 22. – P. 215–234. (Co-authored by Bostanov B., Kenesbayev S., Idrissov S., Turganbay K., 70%)

2. Педагогикалық бағытта білім алатын студенттерге дискретті математиканы оқытудың теориялық негіздері // Science and Life of Kazakhstan, an international scientific journal. – Astana, 2020. – №5/2. – P. 265-268. (100%);

3. Болашақ информатика мұғалімдерін дайындаудағы дискретті математика элементтерін оқыту мәселелері // Bulletin of Abai KazNPU, series «Physics and Mathematical Sciences». – 2021. – № 4(76). – P. 156-161. (Co-authored by Bostanov B.G., 70%);

4. Болашақ информатика мұғалімдерін оқытуда дискретті математика элементтерін қолдану // Bulletin of Abai KazNPU, series «Physics and Mathematical Sciences». – Алматы. – 2022. – №3 (79). – P. 278-286. (Co-authored by Bostanov B.G., Tleubay S. Sh., 70%);

5. Информатика ғылымында дискретті математиканың алатын орны // Materials of the International Scientific and practical conference «Modern trends in pedagogical education». – Taraz. – 2019. – P. – 26-28. (Co-authored by: Bakirova E.A., 70%);

6. Необходимость преподавания элементов дискретной математики будущим учителям информатики // Materials of the International Scientific and practical conference «Physics and mathematics education: goals, achievements and prospects». – Minsk. – 2021. – P. – 168-171. (Co-authored by Bostanov B.G., 70%);

7. Дискретті математика элементтерін оқытуда цифрлық білім беру ресурстарын қолданудың тиімділігі // Materials of the Republican scientific and practical conference «Digital transformation in the educational process and applied software». – Kyzylorda. – 2022. – P. – 356-358. (Co-authored by Bostanov B.G., 70%);

8. Цифрлық білім беру жағдайында болашақ информатика мұғалімдерін дайындауда дискретті математика элементтерін оқытудың әдіс-тәсілдері // Abstracts «VII World Congress of Turkic World Mathematicians (TWMS Congress-2023)». – Turkestan. – 2023. – P. – 529-530. (Co-authored by Bostanov B.G., Kenesbaev S.M., 70%);

9. Информатиканы оқытудағы дискретті математика элементтері: text book. – Алматы: 2024. – P. 288. (Co-authored by Bostanov B.G., Auelbekov O.A., 70%);

10. Информатиканы оқытудағы дискретті математикалық тәсілдер // Computer program. – Copyright certificate №54158, 04.02.2025, (Co-authored by Bostanov B.G., 80%).