

## ABSTRACT

**of the dissertation work by Zhalgas Akhmetov on the topic «Methodology for the formation of students' professional orientation through a system of stochastic-game exercises», submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D010900-«Mathematics».**

**Relevance of the Research.** Modern society demands from professionals not only deep expertise but also the ability to adapt to a rapidly changing world, think critically, and make unconventional decisions. Traditional teaching methods do not always meet these needs, highlighting the necessity of integrating innovative approaches into the educational process.

At the Republican Congress of Educators (October 5, 2023), President Kassym-Jomart Tokayev emphasized the need to prepare the new generation for future challenges by developing skills aligned with contemporary demands. He noted that *«by 2050, up to half of today's professions are expected to be replaced by digital and technical systems»*. Consequently, citizens must acquire skills relevant to the new era, and continuous learning should become a lifelong process.

The Professional Standard «Teacher» in Kazakhstan defines the key competencies required of modern educators and the fundamental requirements for their professional activities.

1. Methodological and Digital Competencies: The standard emphasizes the need for teachers to develop methodological and digital competencies, directly linked to the implementation of innovative educational technologies. These technologies should enable the modeling of real-world professional situations, fostering students' pedagogical mastery, critical thinking, independent decision-making, and adaptability to changing conditions.

2. Professional Orientation of Students: The standard highlights the importance of fostering students' professional orientation. Teachers must not only transmit knowledge but also motivate students toward a conscious career choice and a sustained interest in pedagogy. Additionally, it stresses the need for teachers to apply modern educational technologies and approaches that ensure effective learning.

Kazakhstan is undergoing major educational reforms aimed at improving learning quality, adopting a competency-based approach, and modernizing teaching methods. A key focus is enhancing teachers' qualifications and training. Innovative methods help future educators adapt to modern demands, utilize interactive technologies, and develop essential skills in students.

The Unified National Testing (UNT) is a crucial element of Kazakhstan's educational system, assessing graduates' knowledge and influencing their career paths. In recent years, the UNT has been modernized to emphasize logical thinking and applied knowledge. Successful completion now requires not only theoretical preparation but also well-developed strategic thinking skills, which can be cultivated through game-based and problem-oriented teaching methods.

Kazakhstan also conducts teacher certification involving subject knowledge and teaching methodology assessments, along with professional competency evaluations. This system aims to improve education quality and necessitates teachers' continuous development and skills enhancement. Incorporating such methods into teacher training and retraining programs will better prepare them for modern educational requirements.

A high-quality methodological foundation for future mathematics teachers and modern approaches to teaching mathematics in pedagogical universities ensure a strong mathematical background for school students. This, in turn, facilitates their success in higher education and professional fields.

The topic of professional development has been extensively studied by scholars such as A. Leontiev, L. Vygotsky, E. Klimov, S. Rubinstein, S. Madiyev, G. Nurgalieva, A. Abylkasymova, A. Suleimenova, M. Tazhibayeva, B. Sydykov, A. Mubarakov, R. Kadirbayeva, and others. Their works focus on motivational mechanisms of career self-determination, personality development in professional activities, and the impact of the educational environment on career choices.

A significant contribution to professional training research is the concept of business games proposed by G. Shchedrovitsky. He argued that professional development occurs through modeling real-life production scenarios. Further exploration of these ideas can be found in the works of S. Malykh, T. Tikhomirov, Y. Kovas, A. Kuzmin, and others, who studied cognitive processes and methods for shaping professional thinking.

Game-based learning technologies as a tool for developing professional competence have been thoroughly examined by N. Shamanov, T. Khanov, A. Dorogin, E. Sobolev, E. Kuznetsova, and others. They highlighted the importance of active learning methods such as problem-based learning, business games, and role-playing, which enhance strategic thinking, analytical skills, and adaptability to complex professional environments.

The application of stochastic methods and probability theory in education has been explored in the works of A. Kolmogorov, P. Laplace, O. Meshkova, E. Kochetova, S. Levchuk, O. Dorozhkina, B. Nurbekov, G. Asanbayeva, and others. Their research demonstrates that modeling uncertain situations helps students develop risk analysis skills, event forecasting, and decision-making abilities under uncertainty.

Studies by D. Solopchenko, I. Strakh, K. Kovaleva, E. Lushnikova, A. Emelyanova focus on situational modeling methods, where randomness is used to teach decision-making skills. This aligns with N. Smirnov's concept of probabilistic learning, which prepares students for working in uncertain environments by solving practical problems based on probabilistic scenarios.

In Kazakhstan's pedagogy, the issue of students' professional orientation is examined in the context of educational system modernization. Works by S. Seitova, S. Madiyev, G. Nurgalieva, A. Suleimenova, M. Tazhibayeva, R. Kadirbayeva, A. Nugusova explore psychological and pedagogical conditions for developing professional orientation, the influence of the educational environment, and gender aspects of career choice.

A review of the literature confirms that developing stochastic-game exercises for fostering students' professional orientation is grounded in fundamental research in pedagogy, psychology, probability theory, and educational technology. The works of G. Shchedrovitsky, A. Verbitsky, N. Smirnov, V. Kabanov, L. Friedman, J. Huizinga, D. Kolb, J. Piaget, A. Kolmogorov, V. Arnold demonstrate that combining stochastic principles, game-based technologies, and digital tools provides an effective methodology for training professionals in uncertain environments.

The analysis of various sources revealed the following contradictions:

1. Didactic contradiction. The difference between the abstractness of mathematical concepts studied in the framework of probability theory, statistics and game theory and the need for their practical application.

2. Psychological and pedagogical contradiction. The difference between the high complexity of perception of stochastic and game models and the need to master them for the formation of professional competencies.

3. Methodological contradiction. The difference between the need for students to develop a professional orientation based on mathematical disciplines (probability theory, mathematical statistics, and game theory) and the difficulty of integrating them into professionally oriented learning.

These contradictions are the basis for choosing a research problem, which consists in identifying and developing pedagogical conditions, principles and methods that contribute to the effective formation of students' professional orientation through a system of exercises in probability theory, mathematical statistics and game theory. She points out the gap between the existing approaches to teaching (traditional methods of teaching probability theory, mathematical statistics and game theory) and the need to form a professional orientation of students.

These contradictions and gaps in our research gave us the reason to choose the topic of our dissertation: "Methodology for the formation of students' professional orientation through a system of stochastic-game exercises."

The purpose of the study is to scientifically and methodologically substantiate the formation of students' professional orientation through a system of stochastic–game exercises.

The object of the research is the educational process, within which the professional orientation of students is formed, as well as methodological approaches used to improve it.

The subject of the research is the development, substantiation and implementation of methodological approaches aimed at integrating stochastic and game methods into the professional training of students.

The hypothesis of the dissertation research is that if stochastic-game exercises are introduced into the educational process, this will contribute to the formation of students' professional orientation, as well as improve the quality of students' professional training.

Based on the purpose and hypothesis of the study, the following research objectives were set:

To identify the main problems of students' professional orientation formation in teaching stochastics and game theory.

- To develop and substantiate a methodology for the formation of students' professional orientation through a system of stochastic – game exercises.
- Prepare recommendations for teachers on the development and use of stochastic game exercises in the educational process.
- Conduct a pedagogical experiment on the implementation of the developed system of exercises and evaluate the impact on the formation of students' professional orientation.

The main idea of the research is to form the professional orientation of students, which will be more effective if the process of studying stochastics and game theory is based on a system of exercises that integrate stochastic methods with future professional activities.

The following research methods were used to achieve the goal and solve the tasks set:

- Theoretical methods: analysis and generalization of scientific literature on stochastics and game theory and their teaching methods, comparative analysis of traditional and innovative approaches to the formation of students' professional orientation, systematic analysis of educational technologies related to the use of stochastic-game exercises.
- Empirical methods: pedagogical experiment, questionnaires and testing of students and teachers to identify motivation, the level of material assimilation and professional orientation, monitoring the learning process to analyze student engagement and the effectiveness of exercises.
- Methods of mathematical data processing: statistical processing of experimental results using mathematical statistics methods, analysis of the dynamics of students' professional orientation based on quantitative and qualitative indicators.

The theoretical and methodological basis of the research was formed by the following approaches:

In the field of probability theory, mathematical statistics and game theory: S. Kaltaev, E. Abildin, J. Piaget, D. Kolb, J. von Neumann, A. Temirbekov, G. Rysbaeva.

In the field of pedagogy and teaching methodology: L.S. Vygotsky, A.N. Leontiev, S. Rubinstein, A. Zhunusova, G. Shchedrovitsky, B. Momynbaev, M. Sarybekov.

In the field of game and problem-based teaching methods: K. Rogers, J. Bruner, A. Kabdeshev, A. Kalimova, P. Ishanov.

In the field of professional education and competence approach: J. Holland, D. Super, G. Nurgalieva, S. Madiev, A. Suleimenova, M. Tazhibayeva, S. Seitova, B. Sydyhov, A. Nugusova, A. Abylkasymova.

Sources of research. 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 study of documents related to 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 and others .

The scientific novelty of the study lies in the fact that:

1. A methodology for the formation of students' professional orientation through a system of exercises in probability theory, mathematical statistics and game theory, integrating stochastic methods with professional tasks, has been defined and scientifically substantiated.

2. A system of exercises based on stochastic game methods has been developed, which helps to increase students' motivation and develop their analytical thinking in the context of future professional activities.

3. Recommendations have been prepared on the use of stochastic-game exercises in the educational process for the effective formation of professional orientation.

4. An experimental verification of the effectiveness of the developed methodology has been carried out, confirming its impact on improving the professional orientation of students and their ability to apply mathematical methods in real conditions.

The theoretical significance of the research results lies in the fact that: a methodology for the formation of students' professional orientation has been developed and scientifically substantiated through a system of stochastic-game exercises, which expands existing scientific ideas about methods for integrating probability theory, mathematical statistics and game theory into professionally oriented learning, contributing to the development of analytical thinking and motivation of students.

The practical significance of the research results lies in the developed system of stochastic-game exercises, which is implemented in the educational process of universities, as well as in the textbooks "Methodological foundations for the implementation of the professional orientation of the course "Probability theory and mathematical statistics"", "Methodological model for the implementation of the professional orientation of the course "Probability theory and mathematical statistics" through a system of exercises", "Methods of solving professionally directed tasks in the course "Probability theory and mathematical statistics"".

The reliability and validity of the research are ensured:

1. A theoretical framework based on fundamental research in the field of pedagogy, probability theory, mathematical statistics and game theory.

2. Using scientifically based research methods, including theoretical analysis, pedagogical experiment, questionnaires, observation and statistical data processing, which allows an objective assessment of the effectiveness of the developed methodology.

3. Empirical verification of the developed system of exercises in the real educational process, which confirms its influence on the formation of students' professional orientation.

4. Statistical processing of the results of a pedagogical experiment, ensuring the reliability of conclusions based on quantitative and qualitative methods of data analysis.

The following provisions are put forward for protection:

1. Methodology of formation of students' professional orientation through a system of stochastic-game exercises, which is the theoretical basis of the research.
2. The developed system of exercises, including stochastic and game models, which is the methodological basis of the study.
3. Recommendations that ensure the successful implementation of stochastic game exercises in the educational process, which meets the basic requirements of teacher education.

Research bases: an experimental study was conducted on the basis of the Zhetysu University named after I. Zhansugurov and the Kazakh National Women's Pedagogical University, KSU Secondary School Gymnasium No. 12 and KSU Station of Young Technicians in Taldykorgan.

The study was conducted in four stages:

The first stage (2016-2017, 2020-2021). A survey of teachers (teachers, undergraduates, doctoral students) was conducted to identify their attitudes to the use of stochastic game exercises. Further, teachers were tested and control work was carried out among students and schoolchildren, which made it possible to fix the initial level of professional orientation of students.

The second stage (2017-2018, 2021-2022). At this stage, the analysis of scientific literature related to the professional orientation of students and game teaching methods was carried out. An experimental methodology, a system of stochastic-game exercises were developed, and criteria for evaluating their effectiveness were determined. The educational institutions where the experiment will be conducted have been identified.

The third stage (2018-2019, 2022-2024). The experiment was conducted in natural conditions of the educational process at universities (Zhetysu University, Kazakh National Women's Pedagogical University), secondary school Gymnasium No. 12 and the Station of Young Technicians. In the control group, the training was conducted according to the traditional methodology, while in the experimental group stochastic-game exercises were used. Collections of tasks and specially designed sets of exercises were used in schools and institutions of additional education.

The fourth stage (2024). The final testing of students and schoolchildren, as well as a repeated survey of teachers, was conducted. Statistical data processing included an analysis of academic performance dynamics, student engagement, and changes in their professional orientation. Positive changes were recorded in the experimental group, confirming the effectiveness of stochastic-gaming exercises. Based on the results of the experiment, recommendations have been developed for their implementation in educational practice.

The obtained research results have been tested:

- during scientific and methodological seminars of the Department of Physics and Mathematics of the Zhetysu University named after I. Zhansugurov, KSU "Secondary School Gymnasium No. 12", as well as at the KSU "Station of Young Technicians" in Taldykorgan.

- during an internship at the "Laboratory for the Study of standards and problems of the educational process of higher Education" of the Center for the

Development of Higher and Secondary Specialized, Vocational Education under the Ministry of Education and Science of the Republic of Uzbekistan, under the guidance of scientific consultant, Doctor of Pedagogical Sciences M. Tajiev in the period from 04/01/18 to 04/30/18.

- the research results have been reported at international scientific and practical conferences, published in international peer-reviewed scientific journals, in journals included in the list of peer-reviewed scientific publications identified by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and also presented in textbooks.

- when studying the discipline "Probability Theory and Mathematical Statistics" at the Zhetysay University named after I. Zhansugurov among 3rd and 4th year students, as well as at the Kazakh National Women's Pedagogical University among 3rd year students. In addition, the elements of the experiment were implemented in secondary school-gymnasium No. 12 in optional classes and during the passage of sections on probability theory and mathematical statistics, as well as in the entertaining mathematics circles of the Station for young technicians.

Publications. The main results and provisions of the dissertation research have been published in various scientific journals and collections, conference proceedings, a total of 26 papers, including:

- articles in journals included in the list of peer-reviewed scientific publications determined by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan - 7;

- articles in international peer-reviewed scientific journals included in the Scopus - 2 database;

- publications in scientific journals - 5;

- articles in the materials of international scientific and practical conferences - 6;

- textbook recommended by the Academic Council of the University - 2;

- other textbooks – 2;

- certificate of entry of information in the state register of copyrighted objects – 2.

The structure of the dissertation.

The introduction provides a justification for the relevance of the study, which emphasizes the need to form a professional orientation of students using stochastic-game exercises. The purpose of the study is formulated, the object of the study and the subject of the study are defined, the hypothesis of the study is developed, the main tasks are defined, the scientific novelty is substantiated, the stages of the study are described, including theoretical analysis, methodology development, experimental verification and processing of the results.

The first chapter presents the theoretical foundations of students' professional orientation. The structure of professional orientation has been developed, including motivational-value, cognitive, emotional-volitional, practical and integrative components. The criteria of professional orientation have been defined, which make

it possible to assess the level of its formation among students. The psychological and pedagogical conditions that promote the effective development of professional orientation in the educational environment are formulated. The approaches to the use of stochastic and game theory tasks in pedagogy are analyzed, and their role in increasing students' motivation and involvement in the learning process is revealed.

In the second chapter, methodological aspects of the formation of students' professional orientation based on stochastic-game exercises are developed. A conceptual model of the methodology is presented, which includes a theoretical justification and basic principles for building a system of exercises. Methodological requirements for the creation of an integrated system of exercises are defined, criteria for their selection and ways of integration into the educational process are formulated. Methodological recommendations for the implementation of stochastic game exercises in educational institutions are formulated, practical recommendations for teachers and adaptation mechanisms for various levels of education are proposed.

The third chapter is devoted to the experimental verification of the developed methodology and its implementation in the educational process. The organization of the pedagogical experiment is described, its stages are determined, and the educational institutions on the basis of which the research was conducted are characterized. The criteria for evaluating the effectiveness of the developed methodology are formulated. The results of the experiment are analyzed, confirming the influence of stochastic-game exercises on the formation of students' professional orientation. Quantitative and qualitative indicators of changes have been identified, indicating the positive impact of the methodology on the educational process.

In conclusion, the final conclusions of the study are presented, the hypothesis put forward is substantiated, and recommendations are formulated for further application of the methodology in educational institutions.

The list of sources used contains scientific papers on the research topic, regulatory documents and other materials used in the course of the work.

The appendix contains the acts of implementation of the developed methodology in educational institutions, as well as additional materials, including questionnaires, examples of exercises and statistical data.