ABSTRACT

to the dissertation of **Nurizinova Makpal Manarbekovna**
for the degree of Doctor of Philosophy (PhD)
in the educational program 8D01502 – Physics
Research topic: Preparation of a future physics teacher in the field of tribology in the professional cycle of disciplines.

The research topic is the preparation of a future physics teacher in the field of tribology in the professional cycle of disciplines.

The purpose of the study Theoretical and practical substantiation of the methodology of training a future physics teacher in the field of tribology in the professional cycle of disciplines and the development of a model of a methodological system.

Research objectives:

- to analyze the current state of the problem of applying selected topics (content) of tribology in educational programs for physics teacher training in higher educational institutions;
- to analyze scientific achievements in the field of technology of the gas-thermal method of spraying wear-resistant coatings based on UHMWPE polymers and to determine methodological approaches for organizing a pedagogical experiment at the center «Surface Engineering and Tribology»;
- to develop a model of a methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines;
- to determine ways to include the topic of the physical foundations of tribology in the university physics course (to select and structure material for various forms of training sessions with students, choose teaching methods, etc.);
- to develop a special course on the physical foundations of tribology, accompanying the teaching of physics to university students;
- to conduct a pedagogical experiment in order to test the hypothesis of the study and provide practical recommendations for using the developed model in the educational process.

Research methods:

- analysis of domestic and foreign scientific and theoretical, educational and methodological, philosophical, social, psychological, pedagogical and methodological literature, generalization, comparison, clarification and patent search of materials on the research topic;
- observation of students and teachers, exchange of opinions; conducting questionnaires; analysis of normative and educational documents, testing, experimental work and statistical processing of results.

The main provisions of the dissertation submitted for defense:

1) the results of the analysis of the current state of the problem of reflecting tribology issues in the educational programs of a number of universities for the training of physics teachers;

2) a model of the methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines, including a complex of

design and research laboratory work on the innovative technology of the gas-thermal method of applying wear-resistant coatings based on ultrahigh molecular weight polyethylene;

3) the results of a pedagogical experiment confirming the effectiveness of the developed model of the methodological system of teaching a future physics teacher in the field of tribology.

The main results of the study:

- the analysis of the state of the problem of reflecting tribology issues in the educational programs of physics teacher training in a number of universities was carried out, which allowed us to state the importance of studying tribology in various educational programs, to identify the need to develop educational and methodological support for this process. The analysis also showed a low level and unsystematic knowledge of university students in the field of tribology, the lack of clear recommendations in the methodological literature regarding the scope of inclusion, teaching tools, and specifics of tribological topics in the training of a future physics teacher. The above results of the analysis, as well as the lack of material and technical experimental and appropriate personnel base, indicate the impossibility of attracting university students to design and research activities on topical issues of tribology;

- the analysis of scientific achievements in the field of technology of the gas-thermal method of spraying wear-resistant coatings based on UHMWPE polymers has been carried out and methodological approaches for organizing a pedagogical experiment in the center "Surface Engineering and Tribology" have been determined;

- a model of a methodological system for training a future physics teacher in the field of tribology in the professional cycle of disciplines of educational programs has been created;

- the methods of including the topics of the physical foundations of tribology in the sections "Molecular Physics", "Mechanics", "Thermodynamics and statistical physics" and "Electricity and Magnetism" of the physics course are determined (material for various forms of educational classes with students – lectures, practical and laboratory classes are selected, teaching methods are selected and the necessary didactic ones are created funds, including electronic resources);

- a special course "Physical foundations of Tribology" has been developed to accompany the teaching of physics to students of higher education institutions: its content includes sections of tribophysics, contains lecture material, methodological guidelines for the implementation of three design and research laboratory works and electronic educational resources for them;

- a pedagogical experiment was conducted in three universities in order to test the hypothesis of the study and practical recommendations for using the developed model in the educational process are presented. The effectiveness of the developed model of the methodological system for training a future physics teacher in the field of tribology is more than 80%.

Analyzing the novelty and significance of the obtained results:

- The first result is new, since for the first time the expediency of studying tribological issues in the professional cycle of disciplines by university students in order to improve their professional and pedagogical training and increase research

competencies has been substantiated. If you purposefully train a future physics teacher in the field of tribology, you can give students a qualitative idea of the process of obtaining fundamental physical knowledge and subsequently apply this knowledge in school practice.

- The second result is new, since for the first time an analysis of scientific achievements in the field of technology of the gas-thermal method of spraying wear-resistant coatings based on UHMWPE was carried out and methodological approaches for organizing a pedagogical experiment at the center "Surface Engineering and Tribology" were determined;

- The third result is new, since for the first time a model of a methodological system for training a future physics teacher in the field of tribology in a professional cycle of disciplines has been created, including a special course "Physical foundations of Tribology", methodological guidelines for the implementation of three design and research laboratory works and electronic educational resources for them.

Compliance with the directions of science development or state programs:

The main idea of the study is related to the development of the Kazakh education system, improving the quality of training of competitive specialists in accordance with the Law of the Republic of Kazakhstan «On Education», the strategic development plan of the Republic of Kazakhstan until 2025, the State Program for the Development of Education and Science for 2023-2029, the national project «Quality Education «Educated Nation», Meets the requirements approved by the Minister education and science of the Republic of Kazakhstan, aimed at solving priorities and tasks, specified in the state mandatory standard of education of all levels of education and other state regulatory documents.

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

During the preparation of the publication, a theoretical analysis of the literature was carried out, as well as an analysis of experimental studies presented in the publications.

1. Research and development of a teaching model for the physical foundations of tribology. // Cypriot Journal of Educational Sciences. — 2022. — Vol. 17(11), — P. 4163-4181. (Co-authors: Skakov M.K., Ramankulov Sh. Zh., Coruh A.) Share of doctoral student – 40%. https://doi.org/10.18844/cjes.v17i11.7659. In this work, the doctoral student participated in the development of the elective course «Physical foundations of Tribology», which includes sections of tribophysics, contains lecture material, methodological guidelines for the implementation of three design and research laboratory works and electronic educational resources for them.

2. Development and Studying of the Technology for Thermal Spraying of Coatings Made from Ultra-High-Molecular-Weight Polyethylene // Coatings — 2023. — Vol. 13, — P. 698. — 2022. — Vol. 8, No. 408. — P. 1–20. (Co-authors: Skakov M.K., Ocheredko I., Tuyakbaev B.T., Bayandinova M.B.) Share of doctoral student – 25%) https://doi.org/10.3390/coatings13040698. The doctoral student participated in the analysis of scientific achievements in the field of technology of the gas-thermal method of spraying wear-resistant coatings based on UHMWPE and identified

methodological approaches for organizing a pedagogical experiment to improve the research competencies of future physics teachers.

3. The development of digital educational materials on tribology and their application in the formation of the professional competence of future physics teachers. International Journal of Innovative Research and Scientific Studies. —2024. —7(4). – P. 1600-1613. (Co-authors: M. Skakov, A. Çoruh, Sh. Ramankulov, M. Nurizinov) Share of doctoral student – 45 %. https://doi.org/10.53894/ijirss.v7i4.3459. In this work, the doctoral student took part in the process of developing digital educational materials for the course of physical foundations of tribology and introduced it into the educational program for future physics teachers.

4. Пәндердің кәсіби циклінде трибология саласындағы болашақ физика мұғалімін дайындаудың қажеттілігі // Bulletin of yassawi University. —2021. —№1 (119). –Pp. 114-123. (Co-authors: Skakov M. K.) Share of doctoral student – 50%. https://doi.org/10.47526/habarshy.vi1.482. In the article, the doctoral student made a significant contribution to the analysis of curricula and educational programs of universities in order to determine the need to train future physics teachers in the field of tribology in the professional cycle of disciplines.

5. The study of the formation of ideas of future specialists about tribology // Bulletin of the National Academy of Sciences of the Republic of Kazakhstan - 2023. -№1(401). – Pp. 212-223. (Co-authors: Skakov M. K., Ramankulov Sh. Zh. Share of doctoral student – 50%. https://doi.org/10.32014/2023.2518-1467.433. The doctoral student took an active part in the ascertaining experiment of future physics teachers aimed at determining the level of formation of ideas about tribology.

6. The methodology of studying the gas-thermal method of coating from UHMWPE in the course of physics specialties of the University // «2nd Online International Conference on Functional Materials and Chemical Engineering», China, April 04-05, 2022. – P.45-46. (Co-author: Skakov M. K.) Share of doctoral student – 50%.

7. A teaching model for the physical foundations of tribology // International Conference on Education in Mathematics, Science and Technology (ICEMST) and International Conference on Research in Education and Science (ICRES) Nevsehir, Turkey, May 18-21, 2023. – P.43. (Co-author: Skakov M.K.) Share of doctoral student – 50%.

8. Physical foundations of tribology // International Conference «Advanced technologies of production and research of materials: new materials and methods (AMM&R 2021)», D. Serikbayev EKTU, February 19, 2021. – P.26. (Co-authors: Skakov M. K., Ramankulov Sh. Zh.) Share of doctoral student – 50%.

9. Трибологияның физикалық негіздері «Физика» білім беру бағдарламасының элективті курсы ретінде // International scientific and practical online conference "Ualiyev readings – 2020" November 26, 2020. -P.207-211. (Co-author: Skakov M. K.) Share of doctoral student – 80%.

10. Болашақ физика мұғалімдерінің трибология саласындағы жобалық және зерттеу қызметі // Materials of the international scientific and practical conference "Pedagogical heritage of Akhmet Baitursynov, problems of modern education: present and future" dedicated to the 150th anniversary of the birth of the teacher of the nation

A. Baitursynov Abai Kazakh National Pedagogical University November 25, 2022-P.400-405. Share of doctoral student – 100%.

11. ЖОО мамандықтарының физика курсында аса жоғарымолекулалық полиэтиленнен жабындарды жағудың газотермиялық тәсілін оқу әдістемесі // International scientific and practical conference "Ualiev readings – 2022" "actual problems of Science and education in the context of modern challenges", dedicated to the 70th anniversary of S. Amanzholov EKU. -2022. - P. 428-435 (Co-authors: Skakov M. K., Ramankulov Sh. Zh., Coruh A.) Share of doctoral student – 80 %.

12. Пәндердің кәсіби циклінде трибология саласында болашақ физика мұғалімін даярлаудың теориялық негіздемесі мен әдістемесі // International scientific and practical conference "Development of research culture of teachers in the system of continuing education: experience and innovations" dedicated to the 75th anniversary of Doctor of Pedagogical Sciences, Professor sh.t. Taubaeva on February 17, 2023 at the Al-Farabi Kazakh National University. Share of doctoral student – 100%.

13. Трибология саласындағы студенттердің жобалау және зерттеу қызметі // International scientific and practical conference "Sultangazin readings – 2023" "current problems of the development of modern education". - March 15, 2023-P. 81-86. Share of doctoral student –100%.

14. Technologies of thermal spraying of coatings made of ultrahigh molecular weight polyethylene // Abai Kazakh National Pedagogical University International Scientific Conference “Inverse and Incorrect problems in Natural Science" Almaty, April 11-12, 2023 (Co-author: Skakov M. K.) Share of doctoral student – 80 %.

15. Development of students' research skills through project-based physics training // Republican scientific and practical conference on the topic "Scientific heritage of Zaki Akhmetov and national values", In honor of the 95th anniversary of Zaki Akhmetov, academician of the National Academy of Sciences of the Republic of Kazakhstan, Doctor of Philology, Professor, laureate of the State Prize and the Sh.Ualikhanov of the National Academy of Sciences of the Republic of Kazakhstan, Honored Scientist of the Republic of Kazakhstan "Modern national education system: traditions, values and innovations", Ust-Kamenogorsk: S. Amanzholov East Kazakhstan University Berel Publishing House, 2023. (Co-author: Ali Coruh) Share of doctoral student – 80%.

16. Formation of design and research competence of future teachers in the field of tribology // International scientific and practical conference dedicated to the 80th anniversary of the South Kazakhstan University named after M. Auezov "Auezov readings-21: new Kazakhstan-the future of our country" February 24, 2024 (Co-author: Ali Coruh) Share of doctoral student – 90 %.