**ABSTRACT**

**The dissertation Ydyrysbayev Darkhan Ualikhanuly for the degree of Doctor of Philosophy (PhD) in the specialty 6D011100 – Computer ScienceS**

cience

**Relevance of the research.** The modern educational environment is characterized by the rapid development of information, communication, and digital technologies. This stage directly affects the effectiveness of the educational process in educational institutions and the professional training of future teachers. In this regard, there is a need to improve the training of future teachers who are highly competent and capable of effectively using digital technologies and educational resources in their pedagogical activities.

In the process of training future computer science teachers in the creation of digital educational resources, it is essential, first of all, to develop their skills in formal description. This is a prerequisite for mastering the system of knowledge, skills, and abilities, which are an integral part of methods of virtual modeling. Furthermore, mastering basic algorithmic structures, applying programming technologies, solving problems through mathematical modeling, working with computer devices and digital technologies, and using programming languages are key professional competencies.

**Research topic:** Methodology for training future computer science teachers in the use of virtualization technologies in digital education.

**Objective of the dissertation research:**To develop a methodology for training based on theoretical and practical foundations for the application of virtualization technologies in digital education.

**Research hypothesis:** If the scientific and methodological foundations for applying virtualization technologies in digital education are systematically implemented in the university educational process, then the professional training and quality of students' knowledge will improve, as these technologies help modernize the content of education in accordance with current requirements and increase students’ competitiveness in the field of computer science and information and communication technologies.

**Research objectives:** In accordance with the research question, subject, purpose and hypotheses, the following objectives were defined:

- identifying the theoretical foundations and analyzing international and domestic experience in preparing future computer science teachers for the use of virtualization technologies in digital education;

- substantiating the effectiveness of training future computer science teachers in virtual machine and virtual reality technologies;

- creating a model for teaching future computer science teachers to use virtualization technologies in digital education;

- developing a methodology for training future computer science teachers in virtualization technology;

- developing analytical and methodological recommendations based on the results of experimental work on training future computer science teachers in virtual machine and virtual reality technologies.

**Methodological and theoretical foundations of the research work:** The study relied on scientific and pedagogical theories and methodological positions, as well as modern scientific research in the field of using virtualization technologies in digital education. The study was based on the state compulsory standard of higher education of the Republic of Kazakhstan, the methodological foundations of the use of digital technologies in education, scientific literature on the effective use of virtualization technologies in the learning process and experimental and pedagogical approaches aimed at forming the professional competencies of future computer science teachers.

**Research methods:** The study used an integrated approach, systematically using theoretical, empirical and statistical methods. In addition, PRISMA methods were used in the process of selecting and analyzing scientific sources.

During the study of the problem of using virtualization technologies in the digital education system based on theoretical methods, the study was deeply analyzed at the theoretical level. In this direction, a systematic review of the works of domestic and foreign scientists was conducted, modern scientific trends and conceptual foundations were considered. The literature that constitutes the theoretical basis of the study was analyzed taking into account modern pedagogical approaches and allowed us to reveal relevant aspects of the use of virtualization technologies in the digital educational space. Information sources were selected based on the PRISMA method based on predetermined criteria and underwent screening and analytical analysis.

The experience of introducing digital educational resources and virtualization technologies into the educational process was studied in the context of empirical methods. The views, perceptions and experience of students were summarized through a questionnaire. A pedagogical experiment was also organized to assess the level of professional skills development and determine the effectiveness of the teaching methods. During the experiment, specially developed working curricula (Syllabus) and teaching aids were used, the effectiveness of which was tested from a practical point of view. Mathematical and statistical methods were used to process and analyze quantitative data obtained using statistical methods. The method was used to assess the reliability and validity of the results obtained, and the effectiveness of the pedagogical impact was proven. Google Forms, Excel and the Wilcoxon T-test were used for statistical processing to check the mean values ​​of the data, standard deviations, correlations and forecasts.

**Scientific novelty of the study:** - the theoretical foundations of forming the readiness of future computer science teachers to use virtualization technologies in digital education are defined; - the effectiveness of teaching future computer science teachers virtual machine technologies and virtual reality virtualization is substantiated; - a model of teaching the use of virtualization technologies in digital education is created; - a methodology for teaching future computer science teachers virtualization technologies is developed; - positive results of experimental work on the comprehensive training of future computer science teachers in virtual machines and virtual reality virtualization technologies are obtained and methodological recommendations are developed. Theoretical significance of the study: studying the use of virtualization technologies in digital education in the training of computer science teachers in higher educational institutions, determining the theoretical and methodological foundations of forming digital competence-based training of a modern teacher based on virtualization technologies, improving the content of special disciplines in accordance with the purpose of the study and presenting the teaching methods are a contribution to the field of theory and methods of teaching computer science and information technology. Reliability and validity of the research results: The results of the experimental verification of the effectiveness of using virtualization technologies in digital education, improving the professional skills of students, introducing the research results into the educational process.

**The provisions submitted for defense:**

1. Theoretical foundations for the formation of the readiness of future computer science teachers to use virtualization technologies in digital education:

1.1 The effectiveness of training future computer science teachers in virtual machines and virtual reality virtualization technologies;

1.2 A model of the methodology for teaching future computer science teachers virtualization technologies in digital education.

2. A methodology for teaching future computer science teachers virtualization technologies has been developed:

2.1 Educational and methodological aspects of using virtual machine and virtual reality virtualization technologies in the educational process: the teaching aid "Principles of Virtual and Augmented Reality" published by "Information and Communication Technologies", "Computer Systems and Networks and Network Security", "Fundamentals of 3D Modeling", "Digital Technologies in Education" the introduction of virtualization technologies of artificial intelligence, virtual machines and virtual reality in the content of disciplines;

2.2 Educational environment for the application of virtualization technologies in the training of future computer science teachers "creation of the auezovvr.ct.ws platform";

2.3 The application of virtualization technologies in the training of future computer science teachers based on the software has been clarified:

3. Positive results of the experimental work and methodological recommendations for the training of future computer science teachers using virtualization technologies of virtual machines and virtual reality:

3.1 Model for the application of virtualization technologies;

- the content and methods of teaching have been updated, new disciplines and training modules have been introduced into the educational process;

- the current programs of universities have been supplemented, educational and methodological complexes adapted to the digital environment have been developed.

**3.2 Methodological recommendations**

- effective ways of introducing virtualization technologies into the educational process of universities have been proposed;

- the presented models and methodological manuals are aimed at updating the content of pedagogical education and improving the quality of education.

Approbation and implementation of the research results:

Within the framework of the research topic, articles were published in national publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan. In particular, the main results and conclusions of the dissertation were published in the form of 10 scientific articles in domestic and foreign scientific publications. Of these, 2 articles are in the Scopus database, 4 articles are in a journal included in the list of scientific publications provided 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 4 articles at international scientific and practical conferences.

1) Article based on Scopus:

- Seidaliyeva G.O., Seidaliyeva G.O., Ydyrysbayev D., Zhakypbekova G., Sydykhov B., Adoption of Distance Education and Mobile Technology by University Students. International Journal of Interactive Mobile Technologies (iJIM), 2022, 17(23), pp. 4-16, Percentile-62 (Q2).

- Ydyrysbayev D., Kakimova L.Sh, Boken G.S., Slambekov Y.T., Urmatova A., & Orazbaev E. Determining the digital transformation in education in the society 5.0 process. International Journal of Emerging Technologies in Learning (iJET), 17(18), pp.136-145. Percentile-86 (Q1).

2) List of articles published in Journals of recommended committees of the Ministry of Science and higher education of the Republic of Kazakhstan on quality assurance in the field of Science and higher education:

- Sydykov B.D., Ydyrysbayev D.U., Moshkalov A.K. Theoretical features of the training of future teachers in the use of digital technologies in the conditions of informatization of education. Bulletin of the Abai Kazakh National Pedagogical University, series of physical and Mathematical Sciences, No. 1 (65), Almaty, 2019 P.117-121.

- Ydyrysbayev D.U. Kemelbekova Zh.s., Ibragimov O.M., Burkitbaeva N.S., Methodology of using CLIL technologies in computer science lessons// International popular scientific journal "Science and life of Kazakhstan", No. 5/3, Astana, 2019. pp. 119-123.

- Sydykhov B.D., Ydyrysbayev D.U. Didactic features of training future teachers to design and use digital educational resources, Science and life of Kazakhstan. - №2/2 2020. Astana, - P. 370-374

- Sydykov B.D., Ydyrysbayev D.U., Batyrkhan Z.A. Application of virtualization technologies in the context of digitalization of education. Bulletin of KazNPU. Abay, series Physical and Mathematical Sciences", No. 2 (74), 2021, 61-67. doi:https://doi. org/10.51889/2021-2.1728-7901.07.

3) List of articles published at international conferences:

- Ydyrysbayev D.U., Sydykhov B.D., Aldeshov S.E. Using digital educational resources based on information and communication technologies/ / problems of the international scientific and practical conference "Auezov readings-17: new perspectives of Science and spirituality in the world space". Shymkent: to them."No," He Said. SKSU, 2019. VOL. 3 (1). Pp. 172-176.

- Ydyrysbayev D.U., Nysanov E.A., Aldeshov S.E., Burkitbaeva N.S., Gasanova Z.A. Organization of control and supervision actions in the use of Digital educational resources/ / melodic readings-18 "materials of the International Scientific and practical conference"spiritual heritage of the Great Abai" dedicated to the 175th anniversary of Abay. Shymkent: to them."No," He Said. SKSU, 2020. VOL. 2. PP. 250-254.

Ydyrysbayev D.U., Sydykhov B.D. Features of the training of future computer science teachers in the context of digitalization of Education / / actual problems of the methodology of teaching computer science and mathematics in a modern school. - 2021. - P.574-577.

- Sydykhov B.D., Ydyrysbayev D.U., Batyrkhan Z.A. Features of preparing future teachers for the use of virtualization technologies in the development of digital educational resources / / international scientific and practical conference dedicated to the 70th anniversary of Doctor of Pedagogical Sciences, Professor Aliyeva. Special issue of the Bulletin of the Kyrgyz State University named after I. Arabaev. Bishkek, 2021. pp. 177-180.

4) Еducational and methodical manual.

- Ydyrysbayev D.U., The principle of virtual and augmented reality, educational and methodological manual, publishing house" Mir", Shymkent, 2025. - 108 P.

5) Copyright certificate:

- Ydyrysbayev D.U., Nysanov E.A. Information educational environment for training "VR, AR, 3D modeling and creation of educational resources" training platform for teachers on the use of virtualization technologies. //certificate of amendments to the State Register of rights to copyrighted objects No. 52331 dated December 2024.The dissertation was completed at the Computer Science Department of the M. Auezov South Kazakhstan Research University and recommended for defense.

**Dissertation structure:** The dissertation consists of an introduction, 3 main sections, a conclusion and a list of references in accordance with the goals and objectives of the study.

Section I of the dissertation structure develops the theoretical foundations of using virtualization technologies in digital education at the university, virtualization technologies of virtual machines and virtual reality, a model of teaching methods for using virtualization technologies in digital education, an analysis of international and domestic experience in this area.

Section II considers the educational and methodological aspects of using virtualization technologies of virtual machines and virtual reality in the educational environment and educational process to clarify and apply virtualization technologies based on software for using virtualization technologies in training future computer science teachers.

Section III assesses the effectiveness of using virtualization technologies in training future computer science teachers, presents methods for organizing a pedagogical experiment and the results of experimental work on the implementation of virtualization technology.