ANNOTATION

to the dissertation of Ydyrysbayev Darkhan Ualihanuly for the degree of Doctor of Philosophy (PhD) in the specialty "8D01503 (6D011100) - Computer Science"

Research topic: Methods of training future computer science teachers on the use of virtualization technologies in teaching digital education

The purpose of the dissertation research: Development of a teaching methodology with theoretical and practical justification for the use of virtualization technologies in digital education.

Research hypothesis: If the scientific and methodological foundations for the use of virtualization technologies in digital education in the educational process of universities are systematically and effectively implemented, then the professional training and quality of knowledge of students will improve, since these technologies will allow modernizing the content of education in accordance with modern requirements, increasing the competitiveness of students in the field of computer science and information and communication technologies gives.

Research objectives: In accordance with the research question, subject, object, purpose, forecast, the following objectives have been defined:

- identification of theoretical foundations and analysis of international and domestic experience in forming the readiness of future computer science teachers to apply virtualization technologies in digital education;
- substantiation of the effectiveness of training future computer science teachers in virtual machine and virtual reality technologies;
- construction of a model of the methodology for teaching future computer science teachers to apply virtualization technologies in digital education;
- development of a methodology for training future computer science teachers in virtualization technology;
- development of 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 applying 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 developing 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, the PRISMA methodology was used in the process of selecting and analyzing scientific sources.

During the study of the problem of applying 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 directions and conceptual foundations were considered. The literature that forms the theoretical basis of the study was analyzed taking into account modern pedagogical approaches and made it possible to reveal the current aspects of the use of virtualization technologies in the digital educational space. Information sources were selected based on the PRISMA methodology based on predetermined criteria and underwent screening and analytical analysis.

The experience of introducing digital educational resources and virtualization technologies into the educational process in the context of empirical methods was studied. The views, perceptions and experience of students were summarized through a questionnaire. A pedagogical experiment was also organized to assess the level of formation of professional skills and determine the effectiveness of the teaching methodology. During the experiment, specially developed working curricula (Syllabus) and methodological manuals 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 data, standard deviations, correlations, and forecasts.

Scientific novelty of the study:

- theoretical foundations for the formation of the readiness of future computer science teachers to use virtualization technologies in digital education are defined;
- the effectiveness of training future computer science teachers in virtualization technologies of a virtual machine and virtual reality is substantiated;
- a model of the methodology for teaching future computer science teachers to use virtualization technologies in digital education is created;
- a methodology for training future computer science teachers in virtualization technology is developed;
- positive results of experimental work on training future computer science teachers in virtualization technologies of a virtual machine and virtual reality 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 for the formation of 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 methodology are a contribution to the field of theory and methodology of teaching computer science, information technology.

Reliability and validity of the research results:

Results of the experimental verification of the effectiveness of using virtualization technologies in digital education, improving the professional skills of students, introducing 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 to use virtualization technologies in digital education.

2. A methodology for training future computer science teachers in virtualization technology has been developed:

2.1 Educational and methodological aspects of using virtual machine and virtual reality virtualization technologies in the educational process: "Principles of Virtual and Augmented Reality" teaching aid published by "Information and Communication Technologies", "Computer Systems and Networks and Network Security", "Fundamentals of 3D Modeling", "Digital Technologies in Education" implementation 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 "auezovvr.ct.ws platform creation" ;

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 experimental work and methodological recommendations for the training of future computer science teachers using virtual machine and virtual reality virtualization technologies:

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.

Testing and implementation of the research results:

Within the framework of the research topic, articles were published in republican 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 outcomes of the dissertation were published in the form of 6 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.

1) Article based on Scopus:

- Orazbekovna, S. G., Orazbekovna, S. G., Ydyrysbayev, D., Zhakypbekova, G., & Sydykhov, B. (2022). Adoption of Distance Education and Mobile Technology by University Students. International Journal of Interactive Mobile Technologies, 17(23). Percentile - 62 (Q2).

- Ydyrysbayev, D., Kakimova, L., Sailaubaikyzy, B. G., Talgatbekovich, S., Urmatova, A., & Orazbaev, E. (2022). Determining the digital transformation in education in the society 5.0 process. International Journal of Emerging Technologies in Learning (iJET), 17(18), 136-145. Percentile – 86 (Q1).

2) List of articles published in journals recommended by the Quality Assurance Committee in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan:

- Sydykhov B., Ydyrysbayev D. and Batyrkhan Z. 2021. Application of Virtualization Technologies in the Context of Digitalization of Education. Bulletin of Abai KazNPU. Series of Physical and mathematical sciences. 74, 2 (Jul. 2021), 61–67. DOI: https://doi.org/10.51889/2021-2.1728-7901.07.

- Sydykov B.D., Ydyrysbaev D.U., Moshkalov A.K. Bilimdi akparattandyru zhagdayynda bolashak mugalimderdi digitsilik tekhnologiy koldanuga daiyndaudy n teoriyalyk erekshelikteri //Khabarshy. “Physics-mathematics gylymdara” series. – No. 1. – P. 65.

- Sydykhov B.D., Ydyrysbaev D.U. Sandyk bilim take resourcetaryn zhobalauga zhane paydalanuga bolashak mugalimderdi dayarlaudyn didaktikalyk erekshelikteri//Kazakhstanny gylymy men omiri. - No. 2/2 2020. – P. 370-374.

3) List of articles published at scientific conferences:

- Ydyrysbaev D.U., Sydykhov B.D. Peculiarities of training future computer science teachers in the conditions of digitalization of education // Current problems of methods of teaching computer science and mathematics in modern school. – 2021. – pp. 574-577.

The dissertation was completed at the Department of Computer Science of the South Kazakhstan Research University named after M. Auezov and recommended for defense.

The structure of the dissertation: 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. Part I of the dissertation structure develops the theoretical foundations of the use of virtualization technologies in digital education at the university, virtual machine and virtual reality virtualization technologies, a model of the methodology for teaching the use of virtualization technologies in digital education, and an analysis of international and domestic experience in this area. Section II examines the educational and methodological aspects of the use of virtual machine and virtual reality virtualization technologies in the educational environment and educational process to clarify and apply virtualization technologies based on software for the use of virtualization

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