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Article

Improving the Methodology for Developing Future Teachers Digital Competence

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Abstract: This article examines the pedagogical mechanisms for developing the digital competence of future teachers and evaluates their effectiveness. As the methodological framework of the study, the internationally recognized TPACK (Technological Pedagogical Content Knowledge) model was adapted and applied to the national higher education system. The experimental research was conducted at Samarkand State Pedagogical Institute, Navoi State University, and Kokand State University, focusing on students' adaptation to the digital environment and self-study skills. Statistical analysis revealed that the performance level in the experimental groups was 10.11% higher than in the control groups, scientifically proving the effectiveness of the developed pedagogical methodology.

Keywords. Future teacher, digital competence, TPACK model, digital learning environment, self-education, pedagogical mechanism, experimental trial, efficiency.

Introduction

Today, in our republic, a radical reform of the education and science sectors, their adaptation to modern development trends, has become one of the most priority areas of state policy.[1] After all, it is not for nothing that our national legislation and strategic programs have set as a priority task "... the creation of a system of automation and comprehensive analysis of education management using information and communication technologies, the further development of electronic resources and distance learning".[2] The successful implementation of this strategic goal, first of all, depends on the personality of the teacher, who is the main driving force of a modern school, and his professional skills. This requires future teachers to receive independent education and correctly use the flow of information.[3] It is also a systemic necessity to create new pedagogical conditions for the formation of integrated skills in future teachers, such as working in a team, analyzing problem situations and finding solutions to them with a creative approach.[4]

Methodology. The methodological basis of this study is aimed at improving the pedagogical mechanism of developing the digital competence of future teachers, putting it into practice and evaluating its pedagogical effectiveness in terms of quantity and quality.[5] In order to systematically organize the process of digital competence development of future teachers and evaluate its effectiveness, this study studied the internationally recognized TPACK model. This model allows researching the digital competence of future educators as a complex integrated system at the intersection of three main components - content (subject matter), pedagogy (teaching methodology) and technology (digital tools).[6]

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In this model, Technological Content Knowledge (TCK) is where technology and content meet. We find technological content knowledge (TCK). TCK is the understanding of how technology and content interact and are constrained by each other. This includes knowing how to use technology to represent and communicate content in new ways, such as using simulations to teach scientific concepts or digital mapping tools for geography.[7][8]

Pedagogical Content Knowledge (PCK). The intersection of pedagogy and content creates pedagogical content knowledge (PCK). This is the specific knowledge about how to teach a particular subject. This includes knowing the best ways to explain difficult concepts, anticipating student misconceptions, and using relevant examples and analogies to make the topic understandable and engaging.[9][10]

Technological Pedagogical Knowledge (TPK). The interrelationship between technology and pedagogy leads to technological pedagogical knowledge (TPK). TPK is the understanding of how teaching and learning can be transformed when specific technologies are used. This includes knowing how to use technology to support different pedagogical approaches, such as using online discussion forums to facilitate collaborative learning or educational programs for individualized instruction.[11][12]

In order to systematically develop the digital competence of future teachers based on this model, it is necessary to assess the level of formation of these components using specific criteria. Within the framework of this methodology, students' digital readiness is diagnosed through three main criterion levels: primary, secondary and tertiary. At the primary level, only instrumental knowledge prevails in the future teacher, while in the process of transition to the secondary level, the mutual integration of pedagogical and structural knowledge becomes noticeable. At the tertiary level, the student demonstrates the ability to independently and creatively solve pedagogical problems in a digital environment, synthesizing all components into a whole.

The role of e-learning resources, distance learning platforms, and modern digital tools in implementing this conceptual model in the process of higher pedagogical education is invaluable. Because the digital competence of a future teacher is formed and improved not only through a fund of theoretical knowledge, but also in the process of practical and pedagogical activities, such as independent learning, information analysis, implementation of team projects, and design of lesson processes in digital format, which are carried out directly in a digital learning environment.[13][14]

Results. In the research process, experimental work was organized to determine the practical effectiveness of pedagogical mechanisms that serve to develop the digital competence of future teachers. In this process, the level of work with digital technologies, adaptation to the electronic learning environment, readiness for independent learning, and attitude to innovative pedagogical approaches of students studying in educational institutions were studied. The results obtained in the experimental process made it possible to determine the importance of pedagogical mechanisms in improving the quality of education.[15]

The main goal of the study is to determine the effectiveness of pedagogical mechanisms aimed at developing the digital competence of future teachers and to develop scientifically based recommendations for their implementation in the educational process.

The objectives of the study are:

to determine the level of use of digital technologies by future teachers;

to study the possibilities of forming skills for effective functioning in a digital educational environment;

to determine through experimental testing the effectiveness of pedagogical mechanisms that serve to develop digital competence;

to develop scientific recommendations for improving the educational process based on the results obtained.

The methodological basis of the research is formed by scientific views on person-centered education, competency-based approach, activity-based learning, and the organization of a digital learning environment. These approaches allow for the systematic formation of digital competence in the process of professional development of future teachers.

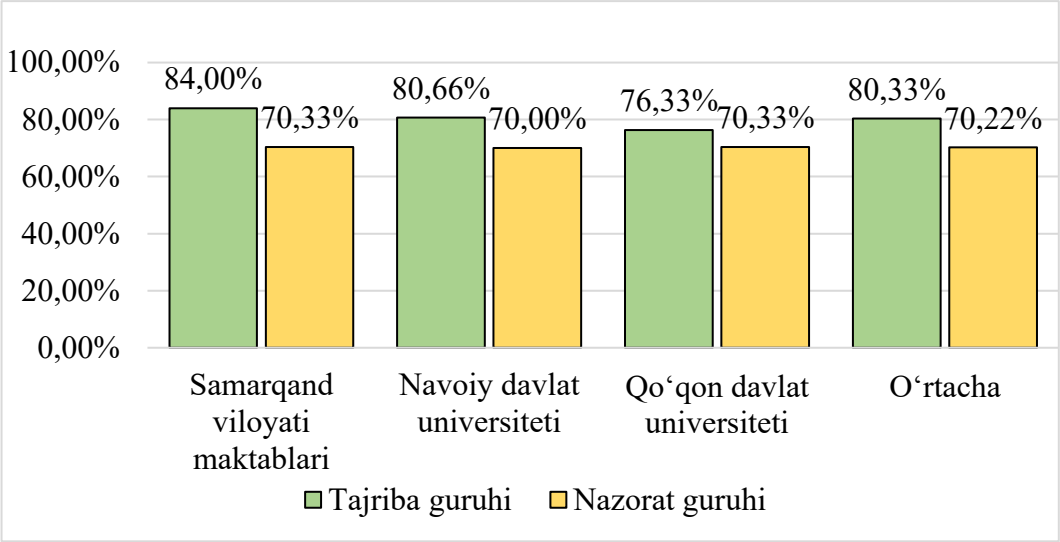
Pedagogical observation, questionnaires, interviews, experimental work and statistical analysis methods were used as research methods. With the help of these methods, the level of digital competence of future teachers, their adaptation to the e-learning environment and readiness for innovative activities were studied.

The components of the studied activity were identified as digital literacy, information skills, use of e-learning resources, independent learning, creative thinking and competencies aimed at self-development. These components play an important role in the professional activities of future teachers and serve their activities in accordance with the requirements of modern education.

Thus, it was determined that studying the effectiveness of pedagogical mechanisms aimed at developing the digital competence of future teachers is of significant scientific and practical importance in modernizing the educational process, increasing the professional potential of teachers, and training specialists who can effectively operate in a digital educational environment.

Results of experimental tests on the development of digital competence in students (in percent)

Universities	Experimental group Control group	Experimental group Control group
Samarkand State Pedagogical Institute	84,00%	70,33%
Navoi State University	80,66%	70,00%
Kokand State University	76,33%	70,33%
Average	80,33 %	70,22 %
Efficiency	10,11 %	



Results of a pilot study on developing digital competence in future teachers (in percentages)

As can be seen from this table and diagram, at the end of the experiment, the overall level of mastery of the experimental and testing grounds in the experimental groups was 10.11% higher than in the control groups.

Thus, the statistical analysis conducted shows that the methodological activities carried out in the experimental and testing grounds organized by the Samarkand State Pedagogical Institute, Navoi State University, and Kokand State University yielded positive results, the methodologies used in the experimental groups are effective, and the results achieved can be popularized in other higher education institutions.

Discussion. The results obtained during the study indicate the need to develop the digital competence of future teachers as a holistic system synthesized with pedagogical and subject content. The systematic introduction of the components of the TPACK model into the teaching process significantly increased not only the technological literacy of students, but also their ability to independently find, sort, process information in the digital environment, and find solutions to problem situations with a creative approach. This fact proves that the high indicators identified in the educational process are directly related to the practical effectiveness of this integrated methodology and serves to develop future teachers in a digital educational environment.

The conclusions of this study fully confirm the theoretical views of international scholars such as P. Mishra and M. Koehler on the interdependence of technology, pedagogy and structural knowledge in teacher training. The uniqueness and novelty of this research is that this model was adapted in close connection with the modern requirements of the higher education system of our republic, in particular, the use of electronic resources and the tasks of automated management of students' independent learning processes. The final results obtained show that the developed pedagogical mechanisms will be an important fundamental foundation for improving the quality of professional training of future teachers, their integration into the modern educational environment, and the formation of the concept of lifelong learning.

Conclusion. In conclusion, in the current era of rapid digitalization, the development of digital competence of future teachers relies on systematic and pedagogically advanced mechanisms. Within the framework of the study, the successful adaptation of the

international TPACK model to the national higher education system and students' independent learning processes allowed to bring the quality of future teachers to a new level. The mutual synthesis of technological, pedagogical and structural knowledge fundamentally formed the skills of future teachers to independently search for and sort information, and to find solutions to educational problems in digital format with a creative and critical approach.

The results achieved during experimental research showed that the developed pedagogical mechanisms have high practical effectiveness. The scientific and practical conclusions obtained will serve to implement the strategic tasks set in our republic in terms of automating education management, further developing electronic resources and the distance education system.

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