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The Training of Future Teachers for Innovative Teaching Activities

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Abstract: The conceptual and methodological principles of future technology teachers' training to the innovative pedagogical activities in terms of postmodern approach are scientifically argued and developed in the article. It is proved that their training becomes effective if it is carried out in according to the defined theoretical and methodological bases of the search, taking into account the main directions of reforming the system of higher pedagogical education in the context of innovative development of Ukraine. The essence and content of readiness of future teachers of technologies for innovative pedagogical activity are revealed, components (motivational, cognitive, activity-technological and creative-reflexive), criteria, indicators and levels of its formation are defined.

The pedagogical conditions of training of future teachers of technologies for innovative pedagogical activity are substantiated; theoretically developed and experimentally tested component model of professionally oriented educational environment of pedagogical free economic zone and structural-functional model of training of future teachers of technologies for innovative pedagogical activity.

The effectiveness of the gradual introduction of methods of training future teachers of technology to innovative pedagogical activities through the use of developed methodological support and improvement of content, forms, methods and means of educational interaction of subjects and objects of educational process environment of pedagogical higher educational establishments was experimentally tested and confirmed using the methods of mathematical statistics.

Keywords: *technology teachers; innovative pedagogical activity; information and communication technologies; model; eLearning.*

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1. Introduction

The realities of the postmodern society require the application of innovative approaches, both to teacher training and to the essence of the future pedagogical activity, which is manifested in various areas: internal and external diversification of secondary and higher education, the formation of new content at all educational levels, the development of new measurement and evaluation training. Accordingly, the requirements for education are changing - it is more flexible, accessible and applied, concentrating on how to teach to think, create, analyze, generate new ideas and find solutions. It is obvious that the transition to a new model of education eliminates the passive role of participants in the educational process, as only an active position in the acquisition of knowledge will shape the transition from the knowledge consumption to the knowledge management and teach them to implement individual education trajectory.

Therefore, future technology teachers must have a significant amount of knowledge and skills in several specializations (training profiles), be able to apply them creatively in teaching, as well as knowledge and practical skills in leading industries of modern production, apply ICT at a high level, and this requires them not only extensive polytechnic knowledge but also technological skills, readiness for innovative pedagogical activity. The relevance of the study is due to the wide range of educational institutions in which the teacher of technology can work (schools, colleges, vocational and extracurricular institutions), conducting various forms of training (lessons, clubs, studios, etc.), the need to solve non-standard professional tasks and combination of several specializations (training profiles).

2. Analysis of recent research and publications

In the conditions of the innovative development of international education the issue of practical readiness of future teachers to the pedagogical activity in a postmodern society became aggravated. The essence of the problem is that the theoretical study of the new scientific approaches, concepts, technologies do not provide a fully effective formation of experience of practical actions, necessary for future teachers to implement the acquired scientific and pedagogical knowledge, skills and abilities, both in everyday and innovative activities. The same issues are relevant for the training of future teachers of technology for innovative pedagogical activities. This, in particular, is mentioned in the works of the following scientists.

Adan Salas-Rueda et al. (2018) use in social networks a technological and pedagogical tool in the process of obtaining higher education. The use of social networks in the self-education of technology and design specialists is investigated in the article (Pashkevich, Yezhova, & Gerasymenko, 2020). Antonio Balladares-Burgos (2018) offers an educational design of digital education for teacher training. Banerjee and Seshaiyer (2019) contribute to the reform of the school mathematics curriculum in India to transform teacher practice through pedagogical innovation. Bernal-Guerrero (2009) substantiates the cyber world in education as a project of a new educational base in a postmodern context. Alimisis (2019) reveals the basics of teacher training in educational robotics in the paradigm of the ROBOESL project. Burden et al. (2019) reveal the principles underlying innovative mobile learning in stakeholder priorities. Byers, Imms, and Hartnell-Young (2018) provide the advantage in assessing the spatial transition of teacher and student from the traditional classroom to the innovative learning environment. Ebenezer, Kaya, and Kassab, D. (2018) single out the reasons for high school students regarding their research orientation: based on innovative environmental technology projects. Hernández-Serrano, and Muñoz-Rodríguez (2020) are interested in STEM disciplines and teaching methods. Krzychala (2020) substantiates the correspondence of knowledge and skills of teachers on the basis of pedagogical practice in the aspect of the praxeological model for studying the school development led by teachers. Lopez Belmonte et al. (2019) reveal the content of variable learning as a necessary direction for learning in the new millennium. Marta-Lazo, Frau-Meigs, and Osuna-Acedo (2019) share the experience of digital pedagogy in MOOC "Step by Step". Neira Piñeiro, Fombella Coto, and Moral Pérez (2019) show the didactic and creative potential of a picture book enriched with digital resources and augmented reality. O'Connor, Seery, and Canty (2018) highlight the research area in developing a model to improve practice in education and science. Pedro et al. (2019) use redesigning the practice of primary teacher education with learning scenarios. Pérez, Zea, and Ocampo (2018) study digital competencies regarding the need for an Ecuadorian teacher in the 21st century. The problem of forming ICT competence of technology teachers is considered in the article (Yezhova, Pashkevich, & Gryn, 2019). Ricardo-Barreto et al. (2020) focus on trends in the use of ICT resources by freelance professors. Sansone and Ritella (2020) are engaged in enhanced teacher training in the aspect of the integration of methodologies and technologies in social-constructivist teaching. Sousa, et al. (2019) are engaged in pedagogical training of a technologist to work as a teacher at the federal institute Amapa - Macapa. Stezhko, Y. G. (2019) promotes the use of

information in computer-based educational technologies and its explication in the imperatives of postmodernism. Young, Cleveland, and Imms (2019) reveal the availability of innovative learning environments for in-depth learning in the pedagogical and architectural fields.

The research aims to substantiate, develop, and experimentally test the theoretical and methodological principles of the future technology teachers training for postmodern innovations in teaching.

The research hypothesis is that the training of future technology teachers for innovative pedagogical activities becomes effective if it is carried out in accordance with the developed theoretical and methodological principles of the study.

3. Research methods

The authors believe that the innovative pedagogical activity is a complex formation, a set of types of work, different in goals and nature, that correspond to the main stages of development of the innovation processes and are aimed at creating and making changes to the teacher's system of work. It is to develop, disseminate, or apply educational innovations; has a complex, multifaceted nature; combines scientific, technological and organizational activities.

3.1. Participants in the experiment.

The research work was carried out on the basis of Vinnytsia State Mykhailo Kotsyubynsky Pedagogical University, Chernihiv National Taras Shevchenko Pedagogical University, Ukrainian Academy of Engineering and Pedagogy, Ternopil National Volodymyr Hnatyuk Pedagogical University, Melitopol State Ivan Franko Pedagogical University, Danylo Halytsky University, Kherson State University and Vinnytsia Higher Educational Institution "Vinnytsia Academy of Continuing Education". 487 students were involved in the study, from the above-mentioned educational institutions and vocational education institutions (VEI) of Vinnytsia and Vinnytsia region. The main composition of the experimental group (EG) - 237 people were students, whose curriculum introduced methods of preparing future teachers of technology for innovative pedagogical activities in the educational process and the selection of the control group (CG) - 250 people were students of these universities in the normal learning process. The age range of the participants of the experiment is 17-24 years. All the participants of the study were informed about the conditions of participation in the experiment and agreed to participate before the beginning of the experiment. The experiment was conducted by the decision of the

specialized scientific council of Vinnytsia State Mykhailo Kotsyubynsky Pedagogical University (protocol № 17 of March 25, 2018). The ethical rights of all participants are respected. The study was conducted in the natural conditions of the educational process of higher educational establishments, providing general conditions for participation in the experiment: the same time and duration of the training, the same measurement methods that diagnose the level of training of future teachers of technology for postmodern innovations in teaching.

The author experimentally tested and confirmed by methods of mathematical statistics the effectiveness of the gradual implementation of methods of training future teachers of technology for innovative pedagogical activities, through the use of developed methodological support and improvement of content, forms, methods and means of educational interaction of subjects and objects of the educational process. oriented educational environment.

3.2. Methods of conducting a pedagogical experiment

The training of future technology teachers for the innovative pedagogical activities was studied in four interrelated stages - from 2018 to 2020: preparatory (2018); ascertaining (April-June 2019); formative (September-October 2019); generalizing (2020).

The readiness of future technology teachers to the innovative pedagogical activities is defined as a stable, multidimensional, multicomponent characteristic of the personality of future teachers, which includes four groups of components (motivational, cognitive, activity-technological, creative-reflexive) between which there are certain functional connections and dependencies. The formation of certain components is considered through the system of motivational-value, gnostic, organizational, constructive-design, communicative, creative competencies that are components of the innovative competence of future teachers of technology (Shevchenko, 2018).

To ensure a unified approach to assessing the performance of each criterion of readiness of future teachers of technology for innovative pedagogical activities, there are four levels ("level" - the degree of size, development, the significance of something): *high (innovative)*, *medium (reproductive)*; *low (initial)*.

Each subsequent level includes requirements for the previous one and adds new ones.

The authors believe that the innovative competence of future teachers of technology is a set of competencies (motivational-value,

cognitive, gnostic, organizational, constructive-design, communicative, creative, reflective and prognostic) related to the main types of innovative pedagogical activity.

The diagnosis of the cognitive component of readiness was carried out by generalizing the knowledge of the subjects about the essence and specifics of the innovative pedagogical technologies, their types and features, as well as a set of skills and abilities to apply innovative pedagogical technologies in the structure of their professional activity. The criteria of its formation are the cognitive readiness of future teachers of technology for innovative pedagogical activities, which includes professionally significant knowledge, knowledge of innovative technologies in the chosen specialty and their innovative potential. In our study, the diagnosis of the cognitive component is based on the results of the session as the average score of exams and tests in the disciplines "Theory and methods of labor and vocational training", "Methods of teaching computer science / Methods of teaching economics / Methods of teaching design basics", "Practice (technological)", "Practice (pedagogical)" (at the active and reflective-creative stages); "Information and communication technologies in scientific research", "Modern pedagogical technologies of education", "Practice (pedagogical)".

The motivational component serves as a basis for structuring the basic properties and qualities of the teacher's personality as a professional; performs a regulatory and indicative function in the process of preparing teachers for innovation. The criterion of its formation is the motivational and value readiness of future teachers of technology for innovative pedagogical activities (system of motives, interests, needs and value orientations, which together reflect the readiness of future teachers of technology for innovative pedagogical activities). The study of the formation of the motivational component of future teachers of technology was conducted on the basis of the method by Bakshayeva and Verbitskiy (2006: 147), adopted by the authors.

Diagnosis of the activity-technological component of readiness was carried out by the application of future teachers of knowledge and ideas about innovative technologies in the chosen specialty and their innovative potential in terms of innovative activities; manifests itself at the level of gnostic (intellectual, information-analytical), organizational, constructive-design construction-design (including professional) and communicative competencies. An author's questionnaire has been developed for diagnosis, which contains 60 test questions, for example: "What are the signs of readiness for innovative pedagogical activity?". The criterion for the

formation of the activity-technological component of readiness for innovative activity is the practical readiness of future teachers of technology to act successfully on the basis of practical experience in solving problems of innovative pedagogical activity.

Diagnostics of the creative-reflexive component of readiness was carried out through awareness, critical analysis and constructive improvement of their activities. Its structure includes the following skills: self-analysis, self-assessment, choice, forecasting, self-regulation of reflections, which allow students to comprehend and adequately assess their motives and interests. The level of reflexivity was determined by a questionnaire (Karpov, 2003).

In the process of research the pedagogical conditions of training of future teachers of technologies for innovative pedagogical activity (creation of a professionally-oriented educational environment of pedagogical higher educational establishments; formation of innovative competence of future teachers of technologies; stimulation of the cognitive activity of students by means of ICT; application of a contextual approach in the training of future technologies teachers, as a set of interrelated necessary and sufficient factors that implement the organization, regulation and interaction of external characteristics of the object (educational process) with the inner world of the subjects (students and teachers), and ensure high efficiency - future preparedness teachers of technology to innovative pedagogical activity.

Thus, the readiness of future technology teachers to the innovative pedagogical activities is considered as a set of motivational, cognitive, activity-technological and creative-reflective components, which through the criteria and indicators of the formation of components represent the structure of future technology teachers for innovation.

Thus, it is substantiated that the cognitive activity and independence of future technology teachers are developed under the influence of cognitive needs, motives, interests in the process of direct cognitive activity. As an initial prerequisite for the continuous development of cognitive activity and independence of future teachers of technology is project activities, the main means of its development - the designed professionally oriented educational environment, and the main condition that forms readiness for innovative teaching - cognitive activity.

To ensure the continuity of the development of the cognitive activity and independence of students, the interrelationship between the activity of cognitive activity and the experience of innovative pedagogical activity of a certain level is important; simultaneous formation of components of readiness for innovative pedagogical activity and components of activation of cognitive activity (motivation, goal-setting, understanding and processing

of information, modeling, concretization, planning, formulation of new ideas, monitoring and evaluation); observance of training stages; systematic use of methods of development of cognitive activity and independence by teachers of pedagogical higher educational establishments (design, interactive, game technologies, problem, modular, vitagenic training, etc.; modeling, etc.).

The research analysis and our pedagogical experience confirmed that the introduction of eLearning in the context of future professional activity is the implementation of a dynamic model of training future teachers for innovative pedagogical activities from learning activities (work in information educational environment, with information educational portal, open educational and electronic learning resources, lectures, seminars) through quasi-professional (project, game, problem-based, interactive learning, virtual modeling, Web-quests, Blog-quests; pedagogical activity through game and project technologies) and educational-professional (practical and laboratory classes, gamification and blended learning, different types of practices, research work, etc.) to the actual innovative pedagogical activity through the reproduction of real professional situations, which, in turn, involves "immersion" in the designed educational environment through the mechanisms of self-programming and self-realization.

In EG, the offered experimental methodology is implemented in the study of such disciplines as "The Information and Communication Technologies in research work", "The Introduction to the profession", "The Methods of teaching the basics of information technology", "The Database management systems", "The Documentation management", "The Educational process in vocational schools". A hybrid electronic educational and methodical complex "Educational process in professional educational institutions" and a textbook on the subject "Information and communication technologies in research" were developed and tested. In which, the selected videos of lessons of theoretical and industrial training, educational activities freed up more time for direct work, communication and discussion.

At the end of the studying a discipline, students presented individual projects prepared in the form of a quest or an educational project, filled with practical material in accordance with the chosen specialization and the specifics of a professional educational institution.

Studying in EG combined traditional classroom classes with online and extracurricular work on the basis of the principle of additionality, integrating training with problem-based and interactive lectures, lectures

with planned mistakes; work in small groups on the model of "flipped classroom", conducting discussions, brainstorming, online testing.

4. Results

At the ascertaining stage, surveys and questionnaires of respondents were conducted, the readiness of freelance teachers, technology teachers and students to use innovative technologies was studied; students' motivational and value orientations, their readiness for self-development are determined; confirmed the need to rethink and adjust views on the role, functions, goals and objectives of training future teachers of technology, determining the organizational, content and methodological parameters that meet the requirements of reform and prospects for modernization of education in Ukraine.

A Survey of the 4th year students after technological and pedagogical practice on the methods of mathematical statistics and computer data processing (MS Excel, SPSS software package) showed that they needed considerable time to adapt to the learning activities during practice (65%), to work in a new team (67%). Only 48% were satisfied with the chosen specialization; 38% were able to work in related specializations of technological education; 72% were interested in obtaining additional specialization; 74% were ready to use ICT; 68% - to the independent development of new knowledge; 55% - to independently perform technical and technological tasks; 42% - to perform applied tasks in related specialization; 58% of respondents prepared an interdisciplinary project, Web or Blog Quest. Students noted that they had difficulties in developing educational and methodological support (57%), implementing project technologies (54%), choosing the most optimal pedagogical methods and tools (61%), developing lesson plans (39%), plans student projects (59%), organization of student project activities (53%).

64% of students stated that they are planning to work in educational institutions after graduation, as the basis of choice noted the possibility of career growth (61%), raising social status (66%), achieving material well-being (58%).

The analysis of the survey results allowed us to conclude that the training of students for innovative pedagogical activities as the determinants of professional mobility should be considered as the willingness and ability of future technology teachers to work in rapid dynamic (horizontal and vertical) changes in professional functions within one professional activity and mastering new specialties (specializations or profiles) in terms of

variability of the content of technological education. It is also important to analyze the readiness of future technology teachers for innovative pedagogical activities based on subjective activity, value orientations, value self-determination, self-realization, self-improvement and subjective experience.

In general, in terms of motivational, cognitive, activity-technological and creative-reflective components, the level of training of future teachers of technology for innovative pedagogical activities in EG is higher than in CG. As can be seen from the Table 1, in EG there was a significantly larger increase in the number of students with a high level of readiness (by 23.7% - from 18.1% to 41.8%) as compared to CG (by 8.0% - from 22.8% to 30.8%). The number of students with a low level of readiness decreased in both groups: by 14.8% (from 34.2% to 19.4%) in EG and by 5.6% (from 31.2% to 25.6%) in CG, and the decrease is more significant in EG.

The results of the experiment are shown on the histogram (Fig. 2).

Table 1. Calculation of measuring the level of students' readiness for innovative pedagogical activities based on the results of the formative experiment

Source: Authors' own conception

Readiness level	Before the experiment				After the experiment			
	CG		EG		CG		EG	
	students	%	students	%	students	%	students	%
Low	78	31.2	81	34.2	64	25.6	46	19.4
Medium	115	46.0	113	47.7	109	43.6	92	38.8
High	57	22.8	43	18.1	77	30.8	99	41.8
Total	250	100	237	100	250	100	237	100
χ^2	1,69				6.79			

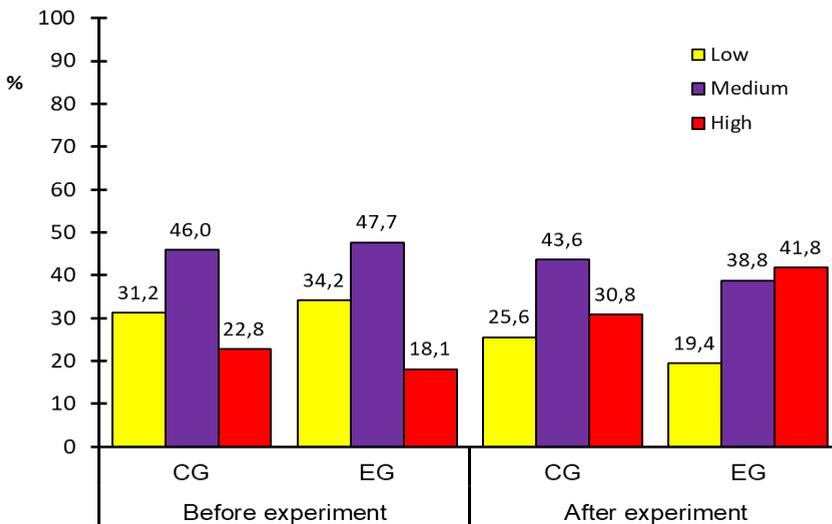


Fig. 2. Levels of readiness of students for innovative pedagogical activity based on the results of the formative experiment

Source: Authors' own conception

The analysis of the survey results confirmed that the implementation of the methodology contributed to the perception of the participants of the EG as a self-actualizing people, which is characterized by perception of reality and a comfortable attitude to it; acceptance of oneself and others; passion for a favorite thing; autonomy, independence from the social environment, independence of judgments; ability to understand other people, attention, kindness to people; constant novelty, the freshness of assessments, openness of experience; the distinction between purpose and means, evil and good; spontaneity, the naturalness of behavior; the sense of humor; self-development, the manifestation of abilities, potential opportunities, creativity in all spheres of life; readiness to solve new problems, to understand the problems, their experience, understanding their capabilities.

Identification of differences between the experimental and control groups was carried out by the criterion χ^2 by comparing the obtained indicator with the table for the significance level $\alpha = 0.05$ ($\chi^2_{0.05} = 5.99$) for the number of gradations 3. As can be seen from Table 1, before the beginning of the experiment the groups were homogeneous ($\chi^2 = 1.69$), and

after the end of the experiment, we state the difference between the control and experimental groups ($\chi^2 = 6.79$).

The stated positive dynamics of the obtained results confirms the effectiveness of the developed methodology of the future technology teachers training to the pedagogical activity, implementation of the pedagogical conditions and developed methods and methodological support for the future teachers of technology training for innovative pedagogical activities based on scientific principles and approaches can significantly improve the quality of training of future teachers of technology in pedagogical higher educational establishments.

The obtained results confirmed the general and partial hypotheses of scientific research, which are the basis of the research concept, and the realized goals and objectives allowed to draw conclusions and formulate recommendations for their use.

5. Results discussion

The requirements of the postmodern society necessitate the modernization of the system of education, which involves changing and improving its components: structure, content, technology, tools, methods of assessing knowledge, etc. The main task of the higher pedagogical education is to train the teachers who have developed personal and professional qualities, able to carry out innovative pedagogical activities. Solving this problem requires purposeful formation of innovative competence of future teachers of technology in the system of higher pedagogical education, contributing to their professional and personal development, formation of innovative potential and innovative culture.

The main advantages of the offered model of teacher training for innovation are accessibility, flexibility, variability, structure, dynamism and rapid updating of information, personalization of education. The disadvantages of using hybrid courses are the lack of motivation, focus and self-organization of both students and teachers, insufficient level of development of new diagnostic technologies.

The methods of training future teachers for innovative pedagogical activities can be used in the educational process of pedagogical higher educational institutions in the international space, in postgraduate education, further training and retraining in order to form and develop innovative competence of teachers of different specialties. The practical significance of the study is confirmed by the possibility of using its results in the development of curricula and manuals on methods of using ICT in the

educational process, as well as training future professionals in various specialties using innovative pedagogical technologies. The research materials can be used in further research on the problems of training future teachers of technology and other subjects on the application of innovative technologies in the educational process of higher education institutions in the aspect of the postmodern approach.

6. Conclusions

The author has developed and put into practice a method of preparing future technology teachers for innovative pedagogical activities, implemented in the dynamics of the educational process during the adaptive-reproductive, active, reflective-creative and productive stages. Each of them is characterized by specific goals and objectives, components of innovative competence, basic forms, methods and means of teaching, electronic educational and methodological complexes of disciplines, as well as methodological mechanisms that ensure the use of theoretical and practical innovations and facilitate the transfer of future teachers in the zone of innovative pedagogical activity, stimulation of reflection and mobility of future teachers of technologies; provides realization in educational process of higher educational establishments of set of pedagogical conditions of training of future teachers of technologies for innovative pedagogical activity; carried out on the basis of methodological support for training future teachers of technology as subjects of innovative pedagogical activities (continuous development of cognitive activity and independence of students, introduction of eLearning in the context of future professional activity and organization of educational process on blended learning technology, formation of professional mobility of future teachers). important conditions of training for innovative pedagogical activity and further professional development) and is checked with the use of appropriate diagnostic tools.

It is substantiated that readiness acts as a stable multidimensional, multicomponent characteristic of students' personality, which includes four main groups of components, namely, motivational, cognitive, activity-technological and creative-reflexive, which meet the requirements of content and conditions of future innovative pedagogical activity. The level of its formation, high (innovative); sufficient (constructive); medium (reproductive); low (initial), mediates the relationship between students' readiness for innovative pedagogical activities and their focus on improving the professional level.

The efficiency of the introduction of methods and methodical maintenance of training of future teachers of technologies for innovative pedagogical activity in the educational process is tested. Analysis of the dynamics of the formation of motivational, cognitive, activity-technological and creative-reflective components of readiness during the four sections of the formative stage of the experiment confirmed that students in EG had significant positive changes in the phenomenon under study.

In general, according to the results of the experiment, the level of training of future technology teachers for innovative pedagogical activities in EG is higher than in CG. In EG there was a significantly larger increase in the number of students with a high level of readiness (by 23.7%) as compared to students in CG (by 8.0%). The number of students with a low level of readiness decreased in both groups: by 14.8% in EG and by 5.6% in CG, and the decrease was more significant in EG. According to the criterion χ^2 for the significance level $\alpha = 0.05$, before the experiment the groups were homogeneous ($\chi^2 = 1.69$), and after the end of the experiment, the difference between the control and experimental groups was stated ($\chi^2 = 6.79$).

The obtained results of the research give grounds to conclude that the hypothesis put forward in the research is confirmed, and the experimental test proved that the readiness of future technology teachers for the innovative pedagogical activity will reach a high level provided theoretical justification and practical implementation of pedagogical conditions and structural-functional model, application of methodical support of training of future teachers of technologies as subjects of innovative pedagogical activity. This suggests that the developed methodology is effective.

Determining the prospects for further scientific research, we note that this scientific work does not claim to be a comprehensive solution to all aspects of the problem. The obtained results testify to the need for an in-depth theoretical and practical study of the problems of preparing future teachers of technology for innovative pedagogical activities in modern postmodern society.

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