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# The use of multimedia technologies in the development of the methodological competence of future teachers

## El uso de tecnologías multimedia en el desarrollo de la competencia metodológica de los futuros docentes

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### Abstract

The main objective of this study was to determine the effectiveness of the use of multimedia technologies in building the methodological competence of future teachers. To achieve this, a mixed methodology was used that combined the application of standardized tests, direct observation, in-depth interviews, evaluation by experts and a training experiment. The main findings of the study reveal that the systematic use of multimedia technologies in the training of future teachers constitutes an effective factor for the development of their methodological competence. A significant impact was observed on the cognitive and motivational components of said competence. The multimedia training system implemented was based on the principles of methodological training and demonstrated a high potential to be integrated into pedagogy educational programs and continuing training courses for teachers.

**Keywords:** competence approach, educational field, future teachers, multimedia technologies, professional training.



## Resumen

El presente estudio tuvo como objetivo principal determinar la efectividad del uso de tecnologías multimedia en la construcción de la competencia metodológica de futuros docentes. Para ello, se empleó una metodología mixta que combinó la aplicación de pruebas estandarizadas, observación directa, entrevistas a profundidad, evaluación por expertos y un experimento formativo. Los hallazgos principales del estudio revelan que el uso sistemático de tecnologías multimedia en la formación de futuros docentes constituye un factor eficaz para el desarrollo de su competencia metodológica. Se observó un impacto significativo en los componentes cognitivo y motivacional de dicha competencia. El sistema de formación multimedia implementado se basó en los principios de la formación metodológica y demostró un alto potencial para ser integrado en programas educativos de pedagogía y cursos de formación continua para docentes.

**Palabras clave:** ámbito educativo, enfoque por competencias, formación profesional, futuros docentes, tecnologías multimedia.

## Introduction

Multimedia tools are part of an integrated strategy for ensuring the quality of modern education (Abdulrahman et al., 2020). Their implementation is a mandatory element of the transformation of the general educational paradigm in modern society (Wallner & Wagner, 2016). The use of modern technologies has significant psychological advantages in learning (Saini & Baba, 2024), which helps to make the educational process more personality-oriented (Deineko, Sotnik & Lyashenko, 2022). Multimedia tools have especially proven their effectiveness in crisis periods of social life, in particular, during the COVID-19 pandemic (Haleem et al., 2022) and full-scale war (Horbatiuk & Polishchuk, 2023). The positive impact of the studied technologies on the effectiveness of higher education is proven (Riznyk, 2021). The implementation of multimedia technologies in higher education makes it possible to quickly respond to the demands of the information society, stimulate self-learning, develop creative abilities, communication skills, optimize research activities, and establish an information culture (Bhat, Naidu & Singh, 2018; Shunkov et al., 2022).

The problem of using multimedia technologies to train future teachers is insufficiently studied. The use of multimedia technologies in training future art teachers has been researched in some aspects (Davydova, 2017). In particular, this study examines the possibilities of enhancing visibility, creating a professionally oriented learning environment and updating feedback using multimedia tools. The effectiveness of multimedia technologies in visualisation and ensuring quality communication has also been studied in training future English teachers (Rohulska, 2018). The specifics of using multimedia presentations in the training of primary school teachers have been identified (Filatova & Drobina, 2021).

At the same time, the impact of multimedia technologies on building the methodological competence of future teachers remains poorly studied. The problem's significance is exacerbated by the exceptional relevance of methodological training in education (Chernenko, 2021). Therefore, the study of multimedia resources as a factor in building the methodological competence of future teachers has theoretical and practical relevance for the pedagogical field.

The aim of the article is to determine the effectiveness of using multimedia technologies for building the methodological competence of future teachers.

The research objectives:



- 1) analyse the possibilities and principles of using multimedia technologies in higher education;
- 2) determine the criteria and indicators of the level of methodological competence of future teachers;
- 3) determine the effectiveness of the use of multimedia resources for developing the ability to interpret texts in students of different years of study critically.

## Literature Review

### General understanding of multimedia technologies

Multimedia resources are the results of computer technologies manifested in a wide range of products: presentations, animations, multimedia galleries, game applications, video and audio files, e-books, online lessons, virtual and augmented reality (Sayidova & Do'sanova, 2022; Srivani & Hariharasudan, 2020). The main feature of these tools is the targeting of information to different areas of the brain, which activates visual, auditory and kinesthetic sensations with the help of information technologies (Alobaid, 2020). This is achieved through the comprehensive integration of text, audio, and video signals (Guan, Song & Li, 2018). The effectiveness of the use of these products is related to the awareness of their importance and learning the algorithm of use (Tang, Zainal & Li, 2023).

### The use of multimedia technologies in education

The integration of multimedia technologies into the educational process optimizes communication between teachers, parents and students, as well as to ensure the flexibility of the educational process (Anderson & Rivera Vargas, 2020). Their methodologically justified use actualizes creative abilities, develop critical thinking and the ability to solve universal problems (Alzubi, 2023). There is also a positive effect on the students' motivation, which corresponds to the principles of human-computer integration in the context of Education 4.0 (Dhivya, Hariharasudan & Nawaz, 2023). The researchers have recorded intensive stimulation of cognitive interest in multimedia learning (Akinoso, 2020). Multimedia games satisfy the need for new experiences, allow to overcome tension and optimize the environment for the achievement of pedagogical goals (Kartika et al., 2019). An individual learning experience that meets the students' needs and motivations determines the creation of the cooperation and teamwork environment that ensures proper intercultural communication (Gajek et al., 2022). Multimedia technologies determine immersion in the educational process of technology, which contributes to the acquisition of not only educational, but also relevant skills and abilities for socialization (Oliveira & Saraiva, 2023). Informatization and computerization of higher education should take into account the potential impact on the students' academic performance and discipline and be based on methodological developments in view of sociocultural conditions (Chugh et al., 2023).

### The use of multimedia technologies in higher education

The effective implementation of multimedia technologies in higher education is ensured by such components as teacher competence, teaching methods, information and communication technologies (ICTs), and the technological infrastructure of the institution (Mayer, 2020; Miranda et al., 2021). In this context, a particularly positive point is the role of technology in optimizing the students' individual learning trajectory (Qureshi et al., 2021). The integration of multimedia technologies in higher education should be based on the appropriate training of teachers (Pastore, Manuti & Scardigno, 2019), which involves the ability to adapt traditional teaching methods to the current information environment (Aydın & Uştuk, 2020). This ensures the orientation of the educational process towards students' practical abilities and skills in accordance with the current and the near future requirements (Matsumoto-Royo & Ramírez-Montoya, 2021). An important task is the purposeful, systematic work of the administration of HEIs in this direction (Adlet et al., 2022). The problem of using multimedia technologies in the professional training of future specialists is of particular relevance. The implementation of video materials is effective for this process



(Noetel et al., 2021). Professional training in the context of the use of multimedia resources involves the implementation of preparatory, main and supporting stages, which is reflected in theoretical, practical, and control training blocks (Kashuba, Asauliuk & Diachenko, 2019). Multimedia presentations, interactive whiteboards, and electronic textbooks have proven effective in training future teachers (Filatova & Drobina, 2021). Multimedia technologies in the process of education of future teachers activate feedback, increase creativity, and ensure better assimilation of educational material (Rohulska, 2018).

So, the theoretical literature review shows that the problem of using multimedia technologies in the educational process is represented by a fairly large number of works. The study of their implementation in higher education is relevant. Such research focuses on multimedia technologies as visualisation tools in the training of specialists. However, researchers mainly focus on the problems of enhancing students' knowledge in the context of an interactive environment. At the same time, research into the possibilities of multimedia resources for building the methodological competence of future teachers is not deep enough. The analysed theoretical literature does not identify clear links between implementing multimedia technologies and forming professional competence and self-awareness of a pedagogical specialist. Abstract theoretical schemes often do not find specific use in practical areas of higher education. The proposed study allows us to identify causal trends in the technological support of professional training and professional development of students in the pedagogical field.

## Methods and materials

The study was conducted in the period from September 2023 to February 2024 with the following *stages*:

Research planning – development of an algorithm for carrying out the research. At this stage, the theoretical literature of the issue under research was analysed. The general features of the use of multimedia technologies in professional training in the context of higher education were determined. The structure of methodological competence of future teachers was been determined separately (Chornous, 2020; Patyk et al., 2022). It includes the following components: motivational (professional motives), cognitive (knowledge about the implementation of teaching methods), activity (specific abilities and skills of methodological training), reflective (introspection of one's own teaching). The research hypothesis is advanced — a theoretically and methodologically justified system of using multimedia technologies in the educational process of future teachers is an effective factor in building their methodological competence. The organizational aspects are also defined at the research planning stage: research bases, samples, tools, specifics of data collection and analysis.

The empirical stage included the primary diagnostic test, experimental influence, and repeated diagnostic test. The data on the influence of multimedia technologies on the methodological training of future teachers were collected. The standard academic scheme of a formative experiment was implemented. This stage was implemented in the context of the natural science paradigm.

The data processing and interpretation stage included quantitative and qualitative analysis of the obtained data. Trends in each component of the methodological competence of future teachers were analysed. Thorough statistical and interpretive methods were used in order to obtain reliable results. At this stage, the data of the first and second diagnostic tests were compared for the control group (CG) and the experimental group (EG).

## Instruments

Such tests as The Level of Satisfaction with the Profession and Self-Assessment of the Level of Ontogenetic Reflection were used. These methods were used to determine the dynamics of the motivational and

reflective component of methodological competence. We were guided by the reasoning that the general development of reflection will determine the level of professional self-analysis. Specialized tests were also used to diagnose knowledge about the implementation of the teaching methodology for a specific subject, which reflected indicators of the cognitive component of methodological competence.

Observation was used to determine the level of formation of the activity component. This method will be implemented in the process of students' educational practice, when there was an opportunity to check the peculiarities of conducting an educational session. We focused on the following criteria in the monitoring process — academic knowledge of the subject, compliance of the model's activities with the structure of the lesson, the implementation of communication with children, the level of use of teaching methods in class. The level of the activity component was determined based on the observation of these criteria. The validity and reliability of the selected diagnostic tools is confirmed by an independent expert evaluation.

Expert evaluation was also used to clarify the data. Teachers with more than 20 years of experience were involved as experts. These individuals did not directly participate in the formative experiment, but conducted independent diagnostics. The experts had to evaluate two criteria of methodical preparation: academic didactic and psychological. The academic didactic criterion reflected the knowledge of the academic subject and the methodological foundations of teaching the educational material. The psychological component showed the level of mastery of communication techniques with students and the ability to take into account their individual and age characteristics in the educational process. The assessment was carried out on a 10-point scale.

A pedagogical formative experiment is the main method of our research, which enabled testing our hypothesis. The independent variable of the experiment is a methodologically justified system of using multimedia technologies during classes. The dependent variable of the experiment is the methodological competence of future teachers. The experiment involved an experimental sample (the presence of an independent variable) and a control sample (the absence of an independent variable). The method is realized in the paradigm of a natural experiment.

## Sampling

*The sample* was formed on the basis of the following educational institutions: Yuriy Fedkovych Chernivtsi National University, Borys Grinchenko Kyiv Metropolitan University, Ternopil Volodymyr Hnatiuk National Pedagogical University, Vasyl Stefanyk Precarpathian National University, Dragomanov Ukrainian State University. The study involved the students of the 3rd-4th year majoring in Secondary Education, specialized in Philology. The samples were formed on the basis of academic groups of students of the respective majors. The entire territory of Ukraine were covered by selecting the subjects from different universities, which will increase the representativeness of the study. The naturalness of the research conditions was preserved as much as possible due to work with selected academic groups. The experimental sample included 94 people, the control sample included 92 people (a total of 186 people). The samples are significantly dominated by female students (174 persons – 94.09%), which reflects the gender specifics of this major. A total of 11 young men (5.91%) participated in the study. The average age of the subjects is 19–21 years.

## Data collection

The research and diagnostics were carried out by the authors of the article. The experimental influence provided for the systematic use of multimedia technologies within the educational components of the respective majors. In the CG, training took place in similar subjects, but without an extensive involvement of multimedia technologies. The experimental influence was carried out in accordance with a number of principles of methodical training, which should be analysed in more detail:



- the principle of motivational provision of the educational process - the implementation of information technologies contributed to the intensification of educational activities through the demonstration of video files and presentations;
- the principle of value orientation – substantiation in the educational process of the importance of acquired competences;
- the principle of vital expediency and effectiveness of knowledge — the use of multimedia technologies helped to activate the connection between theory and practice;
- the principle of intensification of cognitive activity is implemented through the constant use of the problem-based method, which is enhanced by the possibilities of multimedia technologies;
- the principle of directing education towards harmonious development;
- the principle of cooperation and mutual support - support for constant feedback regarding the nature and results of training;
- the principle of personal activity - ensuring the constant implementation of educational and cognitive activities in the learning process;
- the principle of individualization of the educational process is implemented through the differentiation of tasks according to the level of difficulty for students;
- the principle of organic unity of a person, speech and the learning process is reflected in the ability of multimedia technologies to activate various sensory systems.

The experimental programme actively used the capabilities of Web 2.0 technologies. The total time share of their use within the class is 60-70%. At the same time, it is worth noting that the training sessions took place in direct interaction. The experimental effect was implemented within four months.

The data analysis was carried out due to the quantitative and qualitative comparison of the results of primary and secondary diagnostics of the control and experimental groups. The proportional shares and indicators of the average value was calculated. The Student's t-test was calculated using the SPSS software package.

## Results

The analysis of the obtained data of the primary diagnostics demonstrates the maximum initial similarity of both research samples. The indicators in the context of comparing the trends of the CG and EG are presented in Table 1.

**Table 1.**

*Dynamics of indicators of the components of methodological competence of future teachers under the influence of multimedia technologies*

Components of professional competence	Development levels	Number of respondents							
		CG				EG			
		Before the experiment		After the experiment		Before the experiment		After the experiment	
		%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty
Motivational	Low	54.35	50	48.91	45	51.06	48	2.13	2
	Medium	42.39	39	43.48	40	43.62	41	92.55	87
	High	3.26	3	7.61	7	5.32	5	5.32	5
Cognitive	Low	6.52	6	4.35	4	6.38	6	4.26	4
	Medium	65.22	60	63.04	58	65.96	62	54.26	51
	High	28.26	26	32.61	30	27.66	26	41.48	39
Activity	Low	10.87	10	3.26	3	12.77	12	4.26	4
	Medium	76.09	70	53.26	49	71.28	67	60.64	57



	High	13.04	12	43.48	40	15.95	15	35.1	33
Reflective	Low	36.96	34	34.78	32	31.91	30	31.91	30
	Medium	61.96	57	61.96	57	63.83	60	63.83	60
	High	1.08	1	3.26	3	4.26	4	4.26	4

### *Author's development*

In both samples, a low level of professional motivation prevails at the beginning of the study. Such indicators were found in more than half of the subjects. Very few students with a high level of the component were found — 8 people in the total sample. Average values of the motivational component of methodological competence were recorded in approximately 40%. Re-diagnostics showed an insignificant change in results in the CG. At the same time, in the experimental group there is a very significant shift of students with a medium level of the component - by 48.93%. Accordingly, low indicators of the motivational component of methodological competence have significantly decreased. Comparing the results of both samples gives reason to talk about the significance of the use of multimedia technologies in this component. We can state that the use of audio and video files on the subject of educational courses stimulated the students' cognitive interest. In our opinion, the activation of students' motivation occurs through the systematic stimulation of sensory systems and the actualisation of problematic teaching of material. However, multimedia technologies lack the resources to target high levels of motivation, as they only average the levels studied.

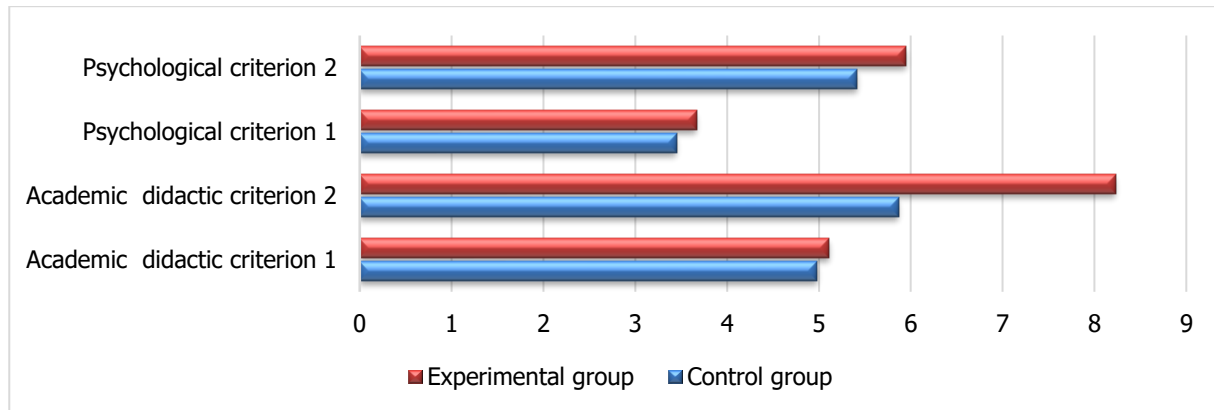
The trends of the cognitive component are analysed below. The vast majority of respondents (more than 60%) have medium indicators of this component of methodological competence. A third of future teachers were diagnosed with high indicators of the component. The smallest percentage of respondents shows low professional motivation. In the CG, no significant dynamics of the component was observed after the end of the experiment. At the same time, the number of studied students with high indicators of methodological knowledge in the pedagogical field increased by 13.82% in the EG. In general, the results indicate a moderate impact of multimedia technologies on the acquisition of theoretical knowledge by future teachers. In this context, we are talking about enhancing visibility possibilities in the multimedia environment to form a holistic view of the methods of teaching future teachers. The visual and auditory components of learning material are stimulated, which correlates with the formation of relevant abstract theoretical schemes.

The trends of the activity component are the following. Medium levels of the abilities and skills of methodical training of the studied students were found in more than 70% of the sample. Low and high values of this component of methodological competence were distributed almost equally. A significant positive shift in the activity component was recorded in both groups. After the experiment, the percentage of people with a high level of methodical skills in the control group increased by 30.44%. In the experimental group, this indicator is 19.15%. That is, positive changes in this component do not depend on the organized influence of multimedia technologies. That is, the formation of specific professional skills is more effective in implementing direct pedagogical situations. Using multimedia technologies creates an imitation effect of practical training, which hinders the productive learning of algorithms of teachers' methodological actions.

The trends of the reflective component are analysed below. Medium levels dominate. Low values were found in a third of the respondents. The results did not change significantly after conducting the formative experiment. Therefore, the use of multimedia technologies does not have a significant impact on the reflective component of methodological competence. Traditional vocational education is not focused on systemic changes in the professional identity of future teachers. This requires a shift in the strategic approach to teacher education. Since multimedia technologies are an auxiliary tool, they cannot change the overall education paradigm.



A corresponding diagram was created for clarity of demonstration of the results of expert evaluation during the experiment (Figure 1). In the figure, the order of diagnostic procedures is indicated by a number: 1 – primary diagnostics; 2 – re-diagnostics.



**Figure 1.** Indicators of criteria for methodical competence of future teachers (primary diagnostics and re-diagnostics)

#### *Author's development*

The chart demonstrates changes in the academic didactic and psychological criteria of methodological competence. Arithmetic means are taken as a basis. The predominance of medium values for the academic didactic component was revealed. More pronounced changes in this criterion are recorded in the EG. According to the psychological criterion of methodical competence, a predominance of below-medium indicators was found. In both groups, moderate positive dynamics are observed as a result of the experimental program using multimedia technologies. The psyche of the studied students is more sensitive to multimedia tools, which can be explained in this situation by the systemic activation of sensory systems as the initial link in the process of acquiring professional competencies.

**Table 2.**

*The value of Student's t-test according to the components of methodological competence of future teachers*

Components of professional competence	Student's t-test	
	Control group	Experimental group
Motivational	1.738	4.009**
Cognitive	1.395	2.330*
Activity	3.198**	3.543**
Reflective	1.391	1.006

#### *Author's development*

The Student's t-test for dependent samples was used to confirm the previous conclusions. The obtained coefficient for the motivational component in the CG indicates the absence of significant changes ( $t=1.738$ ). At the same time, statistically significant differences were found in the EG at the  $p=0.01$  level ( $t=4.009$ ). The cognitive component in the CG has not changed significantly ( $t=1.395$ ), but has significant shifts in the EG ( $t=2.330$ ,  $p=0.05$ ). The obtained coefficients of the Student's t-test for the activity component of methodological competence indicate significant shifts in both groups ( $t=3.198$ ,  $p=0.01$ ;  $t=3.543$ ,  $p=0.01$ ). According to the trends of the reflective component, no significant differences were recorded ( $t=1.391$ ;  $t=1.006$ ). The obtained results of the statistical analysis confirm the results of the previous descriptive analysis.



Analysis of the qualitative characteristics of the conducted formative experiment shows a number of trends revealed in the process of observations. Setting up a problem situation and stimulating cognitive interest were more effective as a result of the activation of complex perceptions of information through the use of multimedia technologies. The use of multimedia presentations combining a video series, pictures, and text blocks (verbal logical schemes) is more pedagogically justified than text presentations. The presence of a verbal component stimulates theoretical thinking, and a visual component causes positive emotional experiences. In the context of practical training, the use of multimedia needs further optimization towards interactivity. Difficulties in orienting the pedagogical education system to real interaction are observed. The development potential of multimedia technologies is revealed through the stimulation of positive emotions in the process of solving problems. Compared to traditional education, computer technologies create more opportunities for the individualization of educational theoretical training due to the use of game elements. At the same time, teachers need to ensure that the emotional component of game-based multimedia methods does not interfere with the performance of professional training tasks. It should be noted that the current study's results were more representative, using more reliable research methods. This determines the need for further development of tools for diagnosing the components of methodological competence, which involves preliminary testing of such tools.

## Discussion

The research confirmed the hypothesis that a theoretically and methodically justified system of using multimedia technologies in the educational process of future teachers is an effective factor in building of their methodological competence. In particular, the impact of multimedia tools on the development of the motivational and cognitive component of the studied competence is quite significant. At the same time, no significant changes were recorded in the CG. We can assume that traditional education is more inert in terms of the development of professional competencies. At the same time, multimedia technologies provide the necessary additional stimulus for students' cognitive interest and work on themselves. The connection between the motivational and cognitive components of the methodological competence of future teachers is also obvious.

The formation of methodological abilities and skills does not significantly depend on the use of multimedia technologies, as it is more determined by the regular implementation of a system of practical actions. It may also be related to the active period of practical training of the surveyed students. Reflection does not change significantly in the educational process. In general, we confirm the conclusions of other researchers about the effectiveness of the implementation of multimedia technologies in higher education (Riznyk, 2021). These tools create favourable psychological conditions in the educational process (Saini & Baba, 2024). It should be noted that the main stages of the implementation of information technologies are preserved in the formative influence: preparatory, main, control (Kashuba et al., 2019).

We agree with the opinions about the positive impact of video materials for professional training of future specialists (Noetel et al., 2021). Multimedia presentations and interactive whiteboards demonstrated their effectiveness in the development of methodological competence (Filatova & Drobina, 2021). One of the leading factors of the positive role of multimedia technologies in educational training is their systemic impact on various sensory systems (Alobaid, 2020). It is promising to improve the used pedagogical tool when designing an environment based on the Education 4.0 principles (Dhivya et al., 2023). According to the results of our research, we can state the importance of modern technologies for the individualization of education (Kartika et al., 2019). In the future, similar pedagogical systems should more actively involve the possibilities of virtual reality and artificial intelligence to increase the immersive effect (Oliveira & Saraiva, 2023). It is also worth to train teachers in the use of multimedia technologies in the educational process (Pastore et al., 2019).



## Limitations

The research was conducted with students studying to become Philology teachers. The obtained results will be more fair for the specified group of future specialists.

## Conclusions

Methodical training of future teachers is one of the key factors in their professional development. In this context, the role of modern information tools for optimizing the professional training of students of pedagogical majors has not been sufficiently studied. As a result of the study, the hypothesis that a theoretically and methodically justified system of using multimedia technologies in the educational process of future teachers is an effective factor in the development of their methodical competence was confirmed. The primary diagnostics revealed the dominance of medium indicators of the methodological competencies. The significant impact of multimedia tools on the motivational and cognitive component was revealed. At the same time, significant changes in these components are not observed in the CG. The activity and reflective components of methodological competence does not depend on the use of multimedia technologies. The multimedia training system was used in accordance with the principles of methodological training of future specialists. Multimedia technologies help to stimulate cognitive interest and more productive acquisition of professional knowledge of methodological competence. This is due to the systematic activation of students' sensory systems. At the same time, the formation of the ability to self-analysis, self-development, and practical skills of methodological competence in multimedia technologies is not observed. The study's results are limited by the composition of the sample and the methodological tools used. The practical significance of the study is the possibility of changing the content and methodology of educational programmes of pedagogical majors. It is necessary to consider the possibility of increasing the efficiency of multimedia technologies to form the activity and reflective components. The solution to this issue lies, in particular, in the integration of artificial intelligence and virtual reality technologies into the technological rationale of higher education. The results can also be used in advanced training courses for teachers of HEIs. The research prospects may be the verification of the basic hypothesis on a wider range of students. In particular, future teachers of natural and social sciences may be involved.

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