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Enhancing creative thinking in future teachers in Kazakhstan through modern intellectual technologies

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ABSTRACT

According to the concept of the "New Kazakhstan" education system, the development of teachers' creative thinking became important. The purpose is to conduct an experimental test of the effectiveness of psychological and pedagogical IT technologies for developing creative thinking. Thus, 60 3rd year students of the Faculty of Pedagogy were involved in the study. The results of the Torrance test showed that the difference between the groups was not statistically significant ($p = 0.47$). The actual experiment lasted 8 weeks and involved the use of modern IT technologies. The tools for determining creative thinking were formed from the Torrance Test (TTST), Guilford's methodology, and the author's test for determining the level of creativity. The results indicate that the experimental group significantly increased average creativity scores after the training (the increase in TTST was +16.29 points). The increase in the control group was half as much. According to the Guilford methodology, there was a significant improvement in such parameters as fluidity (from 24.5 to 31.2) and flexibility of thinking (from 22.7 to 29.6). The conclusions summarize that the active use of IT technologies in teacher education affects the development of the basic creative abilities of students.

Keywords: Creative thinking, Future teachers, IT technologies, Creativity indicators, Impact.

1. Introduction

Due to rapid globalization, the evolution of the education system will accelerate significantly. At the same time, this process requires teachers to acquire complex skills to perform their professional duties, realize their creative potential and emotional flexibility, gain initiative, and apply innovative approaches to teaching. First, this task is important for higher education institutions of the Republic of Kazakhstan, as the educational sector is actively modernizing, including through enhanced integration into the global educational space [1]. Developing creative thinking processes in future teachers will require strategic decisions, as they will influence the creation of new generations of citizens who can respond appropriately to the current challenges of the twenty-first century.

In the system of changes, it is important to define new roles that psychological and pedagogical technologies take on, which are focused on much more active involvement of the intellectual potential of higher education students [2]. Using the potential of introducing IT technologies into the educational process will form completely independent opportunities for further development of the sphere of creativity. First and foremost, virtual environments, separate environments of interactive platforms, educational simulators, and some other digital tools are important, which will contribute to the creation of non-standard thinking, the process of visualizing ideas, and the significantly accelerated exchange of innovative solutions.

As a result of certain trends in the digital transformation of education and the need to meet international standards in teacher training, special attention should be paid to the study of effective psychological and

pedagogical approaches in the gradual evolution of creative thinking processes. Taking such an approach into account would require significantly more resources, but would potentially contribute to the competitiveness of Kazakhstan's education in the international arena. In addition, this approach will contribute to the gradual education of creative professionals with critical thinking who are ready for further professional growth even in the face of dynamic changes in the pedagogical sphere caused by digitalization.

1.1. Literature review

The issue of the evolution of creative thinking in scientific literature covers several important aspects. In particular, the study of this phenomenon is related to the realization of the role of creativity as the main competence of a future pedagogical specialist who can use innovations, adaptation and effective use of non-standard solutions. A significant contribution to the study of the state of creative thinking was made by some scholars who considered creativity an organic ability to generate modern ideas, use unconventional connections between phenomena, and develop skills that cannot be developed using traditional forms of education [3], [4]. Scientific works pay special attention to the diagnostics of creativity, which formed the basis for the following pedagogical technologies and the further evolution of this quality [5]. In the context of the practices of higher education institutions, especially in pedagogical universities, the data obtained by scientists to emphasize the role of active, personality-oriented and developmental learning for the formation of a creative personality - a future teacher - is relevant [6]. The same trend is also present in modern Kazakh scientists who in their studies emphasized the importance of using a creative educational environment in higher education institutions [7], [8], which will stimulate not only the usual acquisition of knowledge and the development of hard skills, but also creative expression among future teachers [9]. Great importance in scientific literature is given to determining the role of psychological and pedagogical technologies, including the use of problem-based learning [10], tested and scientifically proven methods of critical thinking, an important case method [11], certain game and training technologies, project method, etc. For the development of creative potential of students of pedagogical specialties, studies that reveal the importance of personal learning trajectories focused on the training of creative future teachers are also relevant.

An important vector for research is the use of IT technologies to stimulate creativity. For example, some studies have shown that the effectiveness of digital mechanisms in teaching (the use of multimedia presentations, interactive platforms, virtual laboratories) for the development of creative thinking is quite high, especially when considering the conditions of distance or blended learning [13], [14]. However, not all researchers agree with this opinion, pointing to the existing challenges [15] associated with tangible digitalization [16]. Similar studies have also been conducted in Kazakhstan, where the experience of introducing digital resources into teacher training in the national education system has been demonstrated [17], [18].

The study of scientific literature has demonstrated the lack of comprehensive research that could combine existing psychological and pedagogical methods and the development of creative thinking in the context of the current consequences of the total digitalization of education. There is also the challenge of a limited empirical base in the Kazakhstani context, as there is a lack of practical research with concrete results in the Kazakhstani higher education context. This gap is not conducive to considering national characteristics and educational reforms.

Therefore, the analysis of scientific literature indicates that there is a strong scientific interest in the evolution of creative thinking for teacher education, including in Kazakhstan. However, there is a need to apply systematization of psychological and pedagogical technologies, considering modern digital challenges and the global context of education development, which determines the relevance of further research on this problem vector.

1.2. Purpose

The purpose of the proposed article is to experimentally test the effectiveness of using psychological and pedagogical IT technologies for the development of creative thinking among students of pedagogical specialties in Kazakhstan. The fulfilment of this main task will require the implementation of smaller problems:

1. Determination the impact of IT-integrated technologies on the development of creative thinking in students of pedagogical specialties in comparison with traditional teaching methods.
2. Analysis changes in creativity indicators observed after the use of IT technologies.
3. Characteristics of students' attitudes towards the use of IT in education (after the experiment).

2. Research method

The study was implemented using an experimental approach with elements of comparative analysis, which was aimed at analyzing the effectiveness of IT technologies in the development of creative thinking of future teachers. The study involved two groups of students: an experimental group that actively used digital tools to activate their creative potential, and a control group that studied according to a traditional educational program without an emphasis on the IT component. This design was chosen to test the hypothesis that the active use of interactive platforms, gamification, and visualization services contributes to a deeper development of creative thinking. According to modern scholars, the process of IT integration into teacher education allows for the development of critical, divergent, and systemic thinking, which are components of creativity. Therefore, the choice of this research design is aimed not only at comparing traditional and digital learning, but also at pointing out that the reasonable use of IT can influence the transformation of the creative potential of individuals. Results

2.1. Sample and participants

The study used a purposive sample, considering the main inclusion criteria and representativeness by specialty, age, gender, and level of digital literacy. In particular, the inclusion criteria included the following aspects:

1. Studying at the Faculty of Education in the specialties of Primary Education, Psychology and Pedagogy, and Computer Science;
2. Involvement of students of the 3rd year of study;
3. All participants must have basic digital literacy skills (i.e., working with a PC, accessing the Internet, using mobile applications throughout the experiment);
4. Providing informative consent to participate in the study.

Accordingly, the study involved 60 3rd year students of the Faculty of Education of the Kazakh National Pedagogical University (Almaty). Table 1 shows the distribution of the study participants.

Table 1. Distribution of the study participants

Group	**Number of persons**	**Men**	**Women**	**Average age**	Majors
Experimental	30	10	20	20,4	Primary Education (12), Pedagogy and Psychology (10), Informatics (8)
Control	30	9	21	20,2	Primary Education (11), Pedagogy and Psychology (11), Informatics (8)
Total	60	19	41	20,3	

Thus, the sample was gender balanced (≈ 68% women and 32% men), which generally indicates a standard gender profile of pedagogical faculties. The study also considered uniform representation by major. This in turn allowed extrapolating the results to different areas of pedagogical education. The results of the Torrens test determined that the difference between the groups was not statistically significant ($p = 0.47$). This indicated the initial homogeneity of the groups and allows for a broader comparison of the dynamics of the development of creative thinking because of the experiment. The participants were also diagnosed with digital competence using the adapted DigCompEdu questionnaire, which analysed the participants' work with various text editors, platforms, cloud services, etc. Table 2 presents the participants' data on the basic levels of digital literacy before the experiment.

Table 2. Participant’s data on the basic levels of digital

Digital literacy level	Number of students (n = 60)	%
High	14	23,3%
Average	36	60,0%
Low	10	16,7%

2.2. Tools and procedure

To determine the impact of technology on the formation of creative thinking in students, we used a synthesis of digital platforms and psychodiagnostics methods that allowed us to analyze changes in students' cognitive and creative processes.

The following educational IT tools were used in the experimental group:

1. Interactive platforms for the formation of mental maps, collective work on visualization (Miro, Canva).
2. Digital whiteboards for joint generation of ideas (Padlet).
3. Platforms for remote testing of motivational activation.
4. Resources for independent research and group projects.
5. Implementation of special online courses on creativity (Coursera / EdEra / Stepik). This was done with the aim of implementing interactive exercises, simulations, and mini tasks for the development of thinking.

The methods for determining creative thinking consisted of:

- The Torrance Test (TTST) - a tool that allowed us to measure originality, fluidity and speed.
- Guilford's methodology - allowed to assess divergent thinking.
- A test for determining the level of creativity was developed (see Appendix 1).
- A special test evaluation matrix was developed (see Appendix 2).
- A questionnaire aimed at determining the attitude of students to the development of creative thinking by these innovative applications (see Appendix 3).

The experiment procedure consisted of a stating stage (first 2 weeks). At this time, the basic level of creative thinking was identified. Students of both groups took the Torrance test, a developed test for self-assessment of creativity.

The formative stage (8 weeks) involved the experimental group using Miro and Canva every week to create projects. They were to use Padlet daily to capture ideas. Participants from the experimental group also had the opportunity to take the online course “Creative Thinking for Educators” (with elements of gamification). The study participants actively used digital resources and kept a digital diary in Notion. At the same time, the control group was taught in a typical way: regular lectures, discussions, and essay writing. Students in this group also used printed textbooks and had a minimal use of digital tools. The last 2 weeks were the control phase of the experiment. At this stage, the Torrance test was administered again. The final stage also included a questionnaire aimed at determining the attitude of students to the use of IT technologies.

2.3. Data analysis

After the experiment was completed, the results were analyzed to determine the role of involving IT technologies in the development of creative thinking in students of pedagogical specialties. Data processing involved the use of mainly quantitative processing methods. Descriptive statistics played an important role, which was aimed at providing a general idea of the distribution of data in each group. This stage included the use of: 1. Calculation of the mean value (Mean) for each creativity test (Torrance test, Guilford test) Median to determine the central tendency. Standard deviation to analyze the variation of results in each group. Coefficient of variation to compare the differences in the variability of results between the experimental and control groups.

To statistically compare the mean values of the results before and after the experiment in the control and experimental groups, a t-test for independent samples was used. The study also conducted a correlation analysis of the relationship between students' digital competence (level of IT proficiency) and the results of creative tests after the experiment. Therefore, to show the relationship between the intensity of use of IT tools and the increase in the level of creative thinking, the Pearson correlation coefficient was used, since both variables met the conditions of normal distribution.

3. Results and discussion

3.1. Results

To measure creative thinking, the Torrance Test (TTCT) and Guilford's methods were applied. Prior to the experiment, the average creativity scores (according to the Torrance Test) in the experimental group were slightly higher (M = 60.08) than those in the control group (M = 56.08). After the training, both groups demonstrated improved results; however, the increase in the experimental group was substantially greater, amounting to 16.29 points (M = 76.37), compared to an increase of 8.44 points in the control group (M = 64.52).

Additionally, the standard deviation in both groups slightly decreased after the experiment, indicating greater homogeneity in the final measurements, particularly in the experimental group (SD = 6.40 vs. 7.15 at baseline).

The skewness and kurtosis indices confirmed a moderately normal distribution of the results in both groups, suggesting no major statistical distortions. The t-test for dependent samples indicated a statistically significant improvement within both groups ($p < 0.001$). Moreover, a between-group comparison confirmed the significantly positive impact of IT-integrated technologies on the development of students' creative thinking.

Table 3 presents the main statistical indicators of the Torrance Test results in both groups before and after the experiment.

Table 3. The main statistic indicators of the Torrance test result

Group	Indicator	Average	Median	Standard deviation	Min	Max	Asymmetry	Kurtosis
Experimental (before)	Torrance Test	60.08	59.83	7.15	40.61	71.95	-0.51	0.33
Experimental (after)	Torrance Test	76.37	75.91	6.40	64.53	92.06	0.31	-0.10
Control (before)	Torrance Test	56.08	55.40	5.89	46.37	68.46	0.23	-0.81
Control (after)	Torrance Test	64.52	65.46	6.42	52.81	73.54	-0.22	-0.97

Considering specific indicators such as fluidity (the number of ideas generated) and flexibility (the variety of ideas), the experimental group demonstrated a significant increase in the average values for both measures. Specifically, fluidity rose from 24.5 to 31.2, and flexibility increased from 22.7 to 29.6. These results indicate that students in the experimental group were able to generate more ideas and transition more effectively between different approaches and categories of thinking. In contrast, the control group showed less substantial improvement. The fluidity score in this group increased from 23.4 to 26.1, while the flexibility score rose from 21.9 to 24.0.

The difference in growth between the two groups suggests that the use of active IT technologies is more effective in fostering divergent thinking. Additionally, the standard deviation across all dimensions remained at a moderate level, indicating consistent results within groups. Skewness values were close to zero in most cases, confirming that the participants' data followed an approximately normal distribution. The detailed indicators of creative thinking are presented in Table 4.

Table 4. Indicators of creative thinking according to the Guilford methodology

Group	Indicator	**Average**	**Median**	**Standard deviation**	**Min**	**Max**	**Asymmetry**	**Kurtosis**
Experimental (before)	Fluidity	24.5	24.0	4.1	16	33	-0.30	0.10
Experimental (after)	Fluidity	31.2	31.0	3.8	24	39	0.12	-0.20
Experimental (before)	Flexibility	22.7	23.0	3.9	15	31	-0.22	0.05
Experimental (after)	Flexibility	29.6	30.0	3.5	22	36	0.18	-0.10
Control (before)	Fluidity	23.4	23.0	4.0	15	31	-0.20	0.15
Control (after)	Fluidity	26.1	26.0	4.2	18	34	-0.15	-0.05
Control (before)	Flexibility	21.9	22.0	3.8	14	29	-0.18	0.08
Control (after)	Flexibility	24.0	24.0	4.1	17	32	-0.12	

Thus, the data presented from the Guilford methodology indicated the existence of a positive impact of integrating IT technologies into the educational process on the development of fluidity and flexibility as important components of creative thinking for modern teachers.

In the current context of rapid evolution of learning environments, the development of creative thinking processes has become especially important in the training of future teachers. Mastering this ability while studying at higher education institutions would provide students with the ability to generate non-standard solutions, quickly adapt to new challenges, and use innovative approaches to the educational process. As part

of the proposed study, a separate special toolkit was developed to assess the levels of creative thinking among students of pedagogical specialties. This assessment was based on the implementation of several tasks, each of which was aimed at finding very specific aspects of creative potential: the ability to generate new ideas, apply IT tools in future professional activities, think outside the box, and conduct training in an initiative and associative manner. The maximum score for each completed task was 5, and the results made it possible to determine the levels of creativity development in students and to track the effectiveness of the psychological and pedagogical technologies used. The test results showed that there were significant differences between the control and experimental groups (see Table 5).

Table 5. Average test scores

Group	Question 1	Question 2	Question 3	Question 4	Question 5
Control	3.1	2.9	3.0	3	3.1
Experimental	3.6	3.3	3.5	3.4	3.6

Using the t-test formula $t = (\bar{x}_1 - \bar{x}_2) / \text{sqrt}((s_1^2 / n_1) + (s_2^2 / n_2))$ requires several explanations. In particular, it is worth noting that:

$\bar{x}_1$, $\bar{x}_2$ – average values in two samples;
s_1^2, s_2^2 – variances (squares of standard deviations);
n_1, n_2 – sample sizes.

The results obtained can be summarized in Table 6, which indicates the existence of a significant difference between the indicators of the control and experimental groups.

Table 6. Results of the t-test for both groups

Group	Average values	Standard deviation	t-value ($p \geq 5$ for averages)	v-value ($p < 0.05$ – the difference is statistically significant)
Control	3,02	0.0837	6.64	0.00016
Experimental	3,48	0.1304		

Therefore, the proposed study compared the results of the control and experimental groups, which performed the same tasks but used different methods of education and training. In particular, the experimental group used IT tools and other pedagogical approaches, while the control group was taught using traditional approaches. The results of the t-test demonstrated the existence of statistically significant differences between these groups. Accordingly, the difference in average scores is not accidental - it indicates the existence of a real positive effect of the use of IT tools in the training of students in the pedagogical specialty.

After the experiment, students had the opportunity to assess their attitudes toward the use of IT technologies in the learning process. Mostly, the average scores on the questions exceeded 4 points, which indicates a high assessment of the effectiveness and convenience of digital tools. At the same time, 87% of respondents would recommend the use of IT technologies to other students, which emphasizes their satisfaction and confidence in the usefulness of such teaching methods (See Table 7).

Table 7. Satisfaction and confidence in the usefulness of teaching methods

Questions	**Average rating**	**Median**	**Standard deviation**	**Percentage of positive responses (%)**
1. The impact of IT on the development of creative thinking	4.3	4	0.7	-
2. Increasing motivation through digital tools	4.1	4	0.8	-
3. Convenience of digital platforms	4.5	5	0.6	-
4. Recommendation for the use of IT	-	-	-	87% (26 out of 30 students)

The data showed that the integration of modern technologies affects the increase of motivation and creates additional favorable conditions for the development of creative abilities of students of pedagogical specialties.

3.2. Discussion

Considering the main research problem, namely, determining the impact of IT technologies on the development of creative thinking of students of pedagogical specialties, it has been established that their involvement is important for supporting students' creativity.

The results of the study have shown the impact of IT-integrated technologies on increasing the level of creative thinking of students of pedagogical specialties. The experimental group, which used digital platforms (Miro, Canva, Padlet, Notion) and took an online course with gamification, showed an improvement in creativity compared to the control group, which used traditional teaching methods. These results are generally consistent with the findings of several other researchers [19], [20]. They note that the integration of IT resources into the educational process affects the development of critical and creative thinking and allows for a more detailed understanding of the material [21]. This is confirmed by studies that show that modern digital tools increase the flexibility of students' thinking [22]. This, in turn, enables them to generate ideas more effectively. Other studies point out that the introduction of IT technologies also has an additional value, as future teachers receive not only professional knowledge, but also the means to implement creative methods in their own practice. Similar judgments are found in other works [23], which emphasize that the effective use of technology forms an active position and creative approach to solving pedagogical problems in students.

The data obtained from the Torrance test, based on the Guilford methodology, determined the existence of positive dynamics in the indicators of creative thinking. There was a noticeable increase in such indicators as fluidity and flexibility. In the experimental group, after the experiment, there was a significant increase in the average scores: fluidity (from 24.5 to 31.2), flexibility of thinking (from 22.7 to 29.6). These observations are generally comparable to the results of other studies [24], which indicate that the synthesis of technologies in the educational process affects the formation of divergent thinking [3], [25], that is, the ability to generate a wide range of non-standard ideas [26]. According to other scholars [27], the increase in fluidity in creative tasks is explained by the fact that digital tools provide quick access to resources [28], and flexible formats of information presentation affect the development of instant editing of ideas [29]. Such activity generally facilitates brainwork and develops motivation to be more creative. On the other hand, other studies also indicate that the use of visualization and collaboration platforms (such as Miro or Canva) stimulates students' desire to go beyond traditional thinking patterns and thus develops creativity [30]. These thoughts are also confirmed in the studies of other authors, which indicate that learning with the use of IT tools leads to a significant increase in creativity due to the development of multidimensional thinking [31], [32]. However, it should be noted that some scholars have also pointed out that to develop creativity, it is also necessary to combine technology with the development of teachers' pedagogical competence [33], [34]. That is, modern teachers should be proficient not only in teaching skills but also in digital literacy. This will ensure the transfer of knowledge and skills to future generations.

At the same time, the study shows a positive attitude of students to IT-integrated technologies, as recorded in the questionnaire. This indicates the overall effectiveness of the experiment. High average scores on questions about the impact of technology on creativity, motivation, and ease of use of digital platforms, as well as the fact that students are willing to recommend the use of IT to their colleagues, indicate that students have experienced the real benefits of the new learning format. Similar opinions are contained in the works of other authors who have determined that students' positive attitude towards technology is a key factor in its successful implementation in the educational process [8], [35]. In addition, other works indicate that the use of new and innovative tools affects the improvement of students' motivation to learn [36]. All these opinions only further confirm that student motivation is closely related to the use of innovative tools that make learning more interesting, interactive, and personalized [1], [37]. In general, this allows students to feel more control over the learning process and increases their intrinsic motivation to create and learn [1]. However, other works also point to some problems with the introduction of modern technologies [38]. Scientists have recognized that there is a lack of technical support, inadequate material support, etc. [39], [40]. Accordingly, it should be recognized that the synthesis of IT in teacher education should be accompanied by proper support and training [16], [41]. This will help to avoid a decrease in efficiency due to technical or psychological barriers in the future. Thus, the results indicated that IT-integrated technologies affect the increase of the level of creative thinking in students of pedagogical specialties in comparison with traditional teaching methods. The obtained positive changes in such indicators as fluidity, flexibility and originality of thinking are an important result of the active use of digital tools and modern pedagogical online courses.

At the same time, without detracting from the significance of the results, it is also worth pointing out certain limitations that may affect the harmonization of the data. In particular, the study has a limited sample of 60 students. This does not allow us to make broad generalizations about all students of pedagogical programs in Kazakhstan or abroad. It should be recognized that the existence of cultural or institutional differences may affect the effectiveness of IT technology implementation. On the other hand, the not so long duration of the experiment is notable. In particular, the duration of the intervention was limited to 8 weeks, which in general allowed us to show only a short-term impact of technology and changes in creative thinking. Thus, the long-term impact of IT on students' creative abilities remained beyond the scope of this study. However, these limitations only open new directions for studying this complex issue. Future research would be advisable to involve more participants from different regions, universities, and specialties (not just pedagogical). This would allow for a more detailed examination of the stability of the results in the wider educational space. It is also worthwhile determining the long-term impact of technology on creativity in more detail in future studies. It is important to conduct a long-term study that will allow the development of students' creative thinking 6 or 12 months after the experiment.

4. Conclusions

So, the impact of IT-integrated technologies on the development of creative thinking of future teachers is recorded in the research. According to Torrens testing, the experimental group showed improved results: the average value increased from M=60.08 to M=76.37, while in the control group - from M=56.08 to M=64.52. Such indicators showed the effectiveness of IT approaches in comparison with traditional learning.

According to Guilford's methodology, the students of the experimental group significantly increased their fluency (from 24.5 to 31.2) and flexibility (from 22.7 to 29.6). In the control group, the increase was much smaller. This showed that the students of the experimental group generated ideas faster, their thoughts were original. Accordingly, in the conditions of IT-integrated learning, the formation of divergent thinking is noticeable.

According to the questionnaire, students highly rated the impact of IT on the development of creativity (4.3 points), motivation (4.1 points), and the convenience of platforms (4.5 points).

Therefore, the research confirmed the importance of using modern IT technologies for the purpose of developing creative thinking among students of pedagogical education.

Practical recommendations for teachers are several important points:

1. Proven interactive digital platforms (including Padlet, Canva, Miro) should be used for visualization and idea generation.
2. Actively involve students in joint online educational projects. This will have an impact on stimulating flexibility of thinking.
3. Use AI-assisted tools (in particular, generators of ideas, visual solutions) in creative tasks.
4. Take care to ensure reflection through keeping digital diaries

However, this study also opened new suggestions for further research on this topic. Future studies should expand the sample and include students from different regions and universities. An important step will be to highlight the long-term effect of IT use on creativity (after 6-12 months). In this regard, it would be worthwhile to compare the effectiveness of different IT tools and study individual differences in the perception of IT depending on students' learning styles.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

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S. Kaldygozova, M. Pulatova: analysis and interpretation of results; A. Tolbassiyeva: draft preparation; M. Pulatova, A. Oralbekova: critical revision; A. Oralbekova: supervision and project administration. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Appendices

Apendix 1.

Tasks for testing

№	Task description	Skills for assessment	Rating
1	To determine the impact of IT-integrated technologies on the development of creative thinking in students of pedagogical specialties in comparison with traditional teaching methods	Hard knowledge, creativity, ability to generate creative ideas	1–5
2	Describe in detail what tools for distance or blended learning you would use	Creativity, ability to apply modern digital technologies	1–5
3	Describe the implementation of a lesson in a non-standard environment (in a museum, park or theater)	Adaptability, creativity, non-standard thinking	1–5
4	Formulate a methodological idea for students to carry out a pedagogical project	Initiative, application of modern digital technologies	1–5
5	Formulate and justify 3 metaphorical images for the concept of "student motivation"	Imagination, creativity, associative thinking	1–5

Source: Author's own elaboration

Appendix 2.

Proposed test evaluation matrix

№	Task	Criteria for evaluation	1	2	3	4	5
1	Use 5 original ways to engage students in class (2-3 subjects).						
		Less than 2 ideas, superficiality, lack of creativity	+				
		2-3 ideas that can be considered partially new		+			
		3-4 ideas with creative elements			+		
		5 ideas with moderate novelty				+	
		5 original ideas					+
2	Describe in detail what tools for distance or blended learning you would use						
		No answer, or because the answer is off-topic	+				
		Indicated tool, but without description of application		+			
		Indicated tool with superficial description			+		
		Detailed description of tool with description of use of new approaches				+	

№	Task	Criteria for evaluation	1	2	3	4	5
		Detailed description of tool with description of use and innovative practices					+
3	Describe the implementation of a lesson in a non-standard environment (in a museum, park or theater)						
		A template answer or no answer	+				
		A simple transfer of a classroom activity		+			
		Unoriginal ideas			+		
		Adapted ideas with moderate novelty				+	
		A creative form of interaction					+
4	To form a methodological idea for students to implement a pedagogical project						
		Formal answers	+				
		Ideas without explanation		+			
		Trivial ideas			+		
		Creative presentation using modern technologies				+	
		Clear pedagogical goal that integrates IT tools					+
5	Formulate and justify 3 metaphorical images for the concept of "student motivation"						
		No metaphors	+				
		Simple and unoriginal metaphors		+			
		Several simple metaphors and one original one			+		
		3 interesting metaphors related to pedagogy				+	
		3 or more non-standard metaphors that indicate flexibility of thinking					+

Source: Author's own elaboration

Appendix 3.

Questionnaire for students' attitude to the development of creative thinking with the use of IT

Rating on a scale from 1 to 5:
1 means did not contribute at all
5 means contributed significantly

Questions	1	2	3	4	5
1.To what extent do you think that IT technologies contributed to the development of your creative thinking?					
2. Did you feel an increase in motivation to learn thanks to the use of digital tools?					
3. How convenient were the platforms (Miro, Canva, Padlet, Notion) for you?					
4. Would you recommend the use of IT technologies for developing creative thinking to other students?					

Source: Author's own elaboration