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**APPLICATION OF INFORMATION TECHNOLOGIES FOR THE FORMATION AND ASSESSMENT OF STUDENTS' CREATIVE COMPETENCE**

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The use of information technologies for the development of creative abilities of students is a little-studied area of scientific research. It is known that creativity is inherent in any kind of human activity. The philosophical dictionary provides a general definition of creativity as "a process of human activity that creates qualitatively new material and spiritual values ...".

**Key words:** creativity is inherent, socio-historical value, human activity

The Large Psychological Dictionary [2] presents a more detailed interpretation of the definition of "creativity":

**INTRODUCTION**

1) In a narrow sense, creativity is a human activity that generates something qualitatively new that has never been before and has a socio-historical value;

2) In a broader sense, creativity is any practical and theoretical human activity in which new results arise (knowledge, solutions, methods of action, material products).

From the point of view of pedagogy [3], creative development is closely related to the level of assimilation of knowledge, skills and abilities. According to the author of this article, it is fundamentally correct to find the right relationship between two concepts: creativity and learning. The first is directly dependent on the level of the second. The more and better the mastery of skills and abilities occurs, the more freely they operate, the "transfer" from one activity to another, the richer the creative manifestations. In creativity, it is not the skills, knowledge and skills themselves that are important, but the ability to use them to extract new ideas, thoughts, new approaches and solutions.

Based on the analysis of the concepts of "competence", "competence", "creativity", consideration of various classifications of competencies, it can be concluded that "creative competencies" is one of the main links in the classification of the hierarchy of competencies.

This article studies the creative competencies of students, as well as the formation and evaluation of these competencies with the use of information technology. The study of students' creative competencies based on information technologies is of undoubted interest from a scientific and pedagogical point of view.

Here is a review of the literature devoted to this area of research.

In the works [4,5] it is stated that teaching creativity is an important topic of research in the field of pedagogy and creativity. According to the National Advisory Committee on Creative and Cultural Education (NACCCE-National Advisory Committee on Creative and Cultural Education) [6], teaching creativity involves encouraging "young people to believe in their creative potential, using their sense of opportunity and giving them confidence in their attempts" and includes "using

creative approaches to to make learning more interesting and effective." Among the strategies for teaching creativity, technology is considered fundamental. In [7], it was suggested that creative classes require teachers to use information technology effectively. The authors of another article [8] argued that the use of information technology can contribute to the creativity of students.

Despite the multitude of new information technology materials, the effective integration of information technology into the educational process to stimulate the creative abilities of students is a difficult task.

The authors of the article [9] claim that information technology can be used to effectively stimulate students' creativity and is an important area of research. The review conducted in [10] showed that technology acted as a mentor in the creative process, stimulated the creative thinking of students and created a better environment for collective creativity.

The article [11] is devoted to the analysis and the role of educational means of information technology as a tool for improving the competence of students, both the acquisition of basic knowledge, skills and abilities, and the development and improvement of skills and abilities that allow solving non-standard professional tasks.

The article [12] provides an analysis of the advantages and disadvantages of informatization of education, the degree of positive influence of information technology on the educational process, as well as the identification of negative factors of the use of information technology in the learning process for both teachers and students.

The purpose of the study [13] is to study the role of information technology in the development of creativity and motivation of students and university teachers. Nine teachers and 243 students from three groups were interviewed -those who creatively use information technology, those who use these technologies traditionally, and those who do not use information technology. As a result, the professors did not notice the connection between technology and the development of creativity, students and teachers who did not use information technology, more positively assessed the pedagogical practice of creativity.

The relevance of the article [14] is connected with the problem of the formation of creative competence in the information and educational environment of the university. The personality of a "modern" teacher is formed during the rapidly changing information and technological conditions of professional reality at school. The goals of education change very quickly, and teacher training programs depend on the requirements of the modern educational era. The components of the information and educational environment (IOS) of the university provide the result of linking previously studied and new models of educational and pedagogical activity, thus, the creative competence of the teacher is the willingness to see real problems and solve them in the classroom by means of IOS. The creative competence of future teachers presupposes working in new conditions. Consequently, modern IOS resources provide the best opportunities for flexible adaptation to the requirements of the educational system.

In the study [15], an intervention was carried out to increase creativity with the participation of students (90 in total, 46 of them men, 44 women) of an average age of 18.4 in the course of

information systems. The results show that the intervention in general effectively stimulated creativity. There was a statistically significant increase in fluency of speech, flexibility....

The review [16] summarizes relevant research on the use of information technologies in education. In particular, it examines studies that address the advantages of information technology (IT) integration in schools, barriers or problems that arise when using IT, factors affecting successful IT integration, the attitude, perception and confidence of teachers in the process of work and before starting work. This review discusses gaps in the literature and directions for future research to address these gaps.

The article [17] explores the relationship between creativity and information technology (IT) tools in school education. This connection is mainly achieved through (a) discussion of theoretical approaches and empirical data concerning the potential of ICT to support creativity (information technologies have properties that allow students to be creative) and (b) identification of the important role of teachers contributes to the development of creative abilities. In addition, a small-scale study was conducted on a sample of 156 high school students aged 14-15 years. Most of the students reported that ICTs helped (rather than hindered) their creativity, while they mostly mentioned information about awareness-raising and communication via the Internet. The words used to describe "creativity with new technologies at school" were related to their school experience. Playing online games and participating in social networks have been identified as both creative and non-creative activities. It is proposed to develop creativity with the help of ICT in school education.

Together, the existing reviews of scientific articles show the positive contribution of information technology to creativity. At the same time, the authors of the article [18] claim that the review of information technology materials used in the educational process and their impact on the creative abilities of students is absent in modern literature. To fill this gap, a literature review was conducted in [18] and the following opinion was expressed: "given the rapid development of information technologies and their potential to increase efficiency, determining how to effectively use information technologies to improve the creative abilities of students is an important task facing scientists and practitioners." The main contribution of the article [18] is that it is one of the first literature reviews on the impact of information technology products on the creativity of students. A review of this work showed that six categories of digital technology products (preservation and sharing of information, digital games, digital design, digital writing, robotics and virtual learning environment) were studied in existing articles, four methods were used to measure student creativity (creative characteristics of students, results, process and learning environment) and we analyzed five ways in which digital technology products affect the creativity of students (increased motivation, professional activity, higher-order thinking, creative collaboration and cognitive load). This article shows how mixed current research is: some demonstrate the positive impact of technology on the creative abilities of students, and others-negative. In particular, the restraining role of learning strategies and learning behavior in these relationships is discussed. The authors of the article [18] set themselves the task of identifying

research problems on this topic, explaining why research in this area is still at an early stage, and about the existence of great potential for future research in various interdisciplinary fields.

### **MATERIALS AND METHODS**

The authors of the article [19-22] claim that information technology products increase students' motivation for creativity. According to research results [23, 24], information technology products also allow students to acquire professional knowledge and skills and give positive feedback, which increases their self-confidence and motivation for creativity. Other researchers [21, 25-27] reported that information technology products contribute to the development of higher-order thinking in students. In these papers, it was also found that information technology helps students avoid memorization by learning more meaningfully, which gives them more opportunities to practice higher-order thinking skills (such as critical thinking, synthesis, symbolic thinking and reflexive thinking) that benefit creativity.

The authors [28-30] believe that information technologies facilitate joint creativity, which is an increase in creativity. Engaging students in creative collaboration requires teachers to organize, facilitate, and teach, which can be especially difficult in large classrooms. Information technology products can help by bringing together and organizing students to work together creatively, as well as providing creative resources.

Studies conducted in [22, 30-32] show that information technology products increase cognitive load and reduce the creativity of students. It is shown that when using virtual reality products, sound and light stimulation and the mental effect of three-dimensional scenes increased the cognitive load of students and negatively affected their creative components (creative motivation, creative thinking, and professional cognition) and creative design execution (function and novelty).

Thus, the literature review showed that information technology products have changed traditional learning strategies, making mobile learning a reality, instant feedback. Their positive effects include increasing the creative motivation, abilities and professional skills of students, as well as helping to create a virtual environment that promotes creativity. Research on the use of information technology in educational processes in the existing literature offers many useful examples to enhance the creative abilities of students. According to the article [18], the concept of student creativity is quite complex, since it includes student effectiveness, affective state (for example, curiosity), personality (for example, openness to experience), creative thinking (for example, divergent thinking) and creative problem solving, ability (for example, problem definition, idea generation, the choice of an idea, decision-making, implementation, etc.). In addition, these factors can influence each other.

The creative characteristics of students and the creative process should be considered together when trying to study the impact of information technology on the creative abilities of students. Two types of creativity can usually be promoted in the school environment: "Mini creativity" includes personally new and significant ideas or products, and "Small creativity" refers to the everyday creative behavior and insights of students. Creative personality factors, creative motivation, creative thinking and problem solving skills are also important goals of teaching

creativity. Thus, they should be included in efforts to assess the impact of information technology on students' creativity.

For practical demonstration of students' creative competence and their assessment, an experience with the use of information technology was conducted.

28 students of the 5th grades of the 8th secondary school of Navbakhor district of Navoi region participated in experimental studies. For the first time, all students took part in an experimental work on creating a new image in a graphic editor Paint.Net . They were asked to complete this task individually during one lesson without Internet access and without the help of a computer science teacher. The task, for the students, was selected from the 5th grade textbook "Computer Science and Information Technology" [33]:

Create a picture on the theme "Moon and starry sky".

Cut out the background of the sky from the finished image and place it on the first layer, draw a crescent moon and stars on the second layer, and add the word "STARRY SKY" to the third layer and combine all the layers.

Figure 1. An example from the book Computer Science and Information Technology

The drawing assignment in this assignment was chosen as the basis for studying students' creativity because it requires students to promote different approaches and multiple methods. Based on the specifics of the task, the students demonstrated the ability to create a holistic picture and a creative approach.

The students' solutions to this problem were first analyzed from the point of view of the adequacy of the approach to creating a picture, and then evaluated according to three criteria of creativity - usefulness, fluency and originality. Adequacy and three criteria of creativity were defined and applied as follows:

The adequacy of the drawing approach to solving the problem takes into account the expediency and completeness of the approach. In this case, the problem is characterized by a solution not based on one approach, but on the basis of several approaches. The approach was evaluated not only on its correctness, but also on expediency. To assess the high-good-average level of drawing skills, a three-level category scheme was used (Table 1).

Table 1

Qualimetric analysis of high-good-medium-level categories, reflecting the adequacy of visualization approaches

Example		
Level	Description	Task
High	A high level of adequacy is determined when a student can relatively complete and successfully solve the task.	Approaches are determined if they represent the necessary techniques (for example, cropping the background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers) and are done correctly.

Good	A good level of adequacy is determined when a student has the opportunity to solve a task, but makes some mistakes.	Approaches are defined if they represent the necessary techniques (for example, cropping and inserting a background image on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers), but make some mistakes.
Average	Moderate adequacy is determined when a student has the opportunity to solve a task, but does it incorrectly.	Approaches are determined if they take into account the necessary techniques (for example, crop the background image and place it on the first layer, draw a crescent moon and stars on the second layer, and write text on the third layer and combine all layers), but the order of the layers is not observed.

The assessment of students' creative competencies was also objectively analyzed according to three criteria of creativity - usefulness, fluency and originality. The analyses are based on the following definitions:

- The criterion of usefulness is the usefulness of all approaches used in the assessment. The average utility level is assigned when a low-efficiency approach is used, and the high level is assigned when a useful and general approach is used.
- Assessment of the fluency criterion involves the implementation of various approaches. The average level of fluency is given when using one approach, and the high level is given when using different approaches.
- When evaluating the criterion of originality, the relative originality of approaches is assumed. An average level of specificity is assigned to an approach identified by a large number of students, and a high level is assigned to an approach identified by a small number of students.

The description of each category and approaches of students is summarized in Table 2.

Table 2  
Qualimetric analysis of categories of creativity criteria "high-good-average"

Example			
	Level	Task	Descriptions
Utility	High	A high degree of usefulness is given when using approaches that are useful not only for solving this problem, but also common for solving other similar problems.	Approaches include cutting out the background image and placing it on the first layer, drawing a given image on the second layer, writing text on the third layer, as well as useful methods for merging all layers and other similar tasks.

	Good	A good degree of usefulness is given when approaches are used that are useful for solving this problem, but cannot solve another similar problem.	Approaches include cutting out the background image on the first layer, drawing a given image on the second layer, text on the third layer, and useful methods for merging all layers.
	Average	Moderate utility is given when a useless and not fully developed approach is used to solve this problem.	Approaches include cutting out the background image on the first layer, drawing a given image on the second layer, writing text on the third layer, and a method of combining all layers that has not yet been fully developed.
Fluency	High	A high degree of fluency is given when approaches involving different methods are used to solve the problem.	The approaches are defined by cutting out the background image and placing it on the first layer, drawing a given image on the second layer, writing text on the third layer and combining all layers in different ways.
	Good	A good level of fluency is achieved when an approach involving a relatively small number of methods is used to solve the problem.	The approach is as follows: cropping the background image and placing it on the first layer, drawing a given image on the second layer, writing text on the third layer and combining all the layers in a relatively small way.
	Average	Average fluency is given when an approach involving a single method is used to solve a problem.	The approach is as follows: cropping the background image and placing it on the first layer, drawing a given image on the second layer, writing text on the third layer and using only one method to combine all layers.
Originality	High	A high degree of specificity is attached to the approach used by a small number of participants to solve the problem.	The approach is to cut out the background image and place it on the first layer, to draw this image on the second layer and write text on the third layer, and the method of combining all layers is carried out by a small group of students, about less than 15%.
	Good	A good degree of specificity is given to the approach used to solve the	This approach uses the method of cutting out the background image and placing it on the first layer, drawing this image on

		problem by a relatively large number of participants.	the second layer and writing text on the third layer and combining all layers is carried out by about 15-40% of students.
	Average	Average specificity is given to the approaches used to solve the problem by most students.	This approach uses the method of cutting out the background image and placing it on the first layer, drawing this image on the second layer and writing text on the third layer and combining all layers is carried out by approximately more than 40% of students.

First, a descriptive analysis of the task to create a picture was carried out for adequacy and three criteria of creativity. A partial correlation analysis was carried out to determine the relationship between the adequacy of control and the three criteria of creativity.

The results of the students' activities are based on the adequacy of the approaches of cutting out the background image and placing it on the first layer, drawing the image of the crescent moon and stars on the second layer, writing text on the third layer, and the unification of all layers was considered. As can be seen from Table 3, approximately 39.3% of the 28 students had a high level and 46.4% had an adequate approach to creating pictures.

Table 3

Performance indicators of students of different levels of readiness for a given task

Class level	Number of students	%
High	11	39,3%
Good	13	46,4%
Average	4	14,3%

In this process, the activity of students based on creativity was also determined. The students' works were analyzed according to three creative criteria: usefulness, fluency and originality.

### Utility

As can be seen from Table 4, 32.1% of students showed high usefulness, 46.4% showed good usefulness, and 21.5% showed average usefulness.

Table 4

Performance indicators of students of different levels of usefulness for a given task

Class level	Number of students	%
High	9	32,1%
Good	13	46,4%
Average	6	21,5%



**Fluency**

From the table. 5 it can be seen that 17.9% of students presented different approaches to solving the problem.

Table 5

Performance indicators of students of different levels of fluency on a given task

Class level	Number of students	%
High	5	17,9%
Good	13	46,4%
Average	10	35,7%

**Originality**

As can be seen from Table 6, 46.4% of students showed an average level of originality in completing the task. Because the method used by a large number of students when completing the task was chosen.

Table 6

Performance indicators of students of different levels of specificity for a given task

Class level	Number of students	%
High	4	14,3%
Good	11	39,3%
Average	13	46,4%

The study also examined aspects of the interdependence of various criteria of creativity in the assessment of creative competencies. The relationship between different criteria of creativity is analyzed, including students cutting out a background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all the elements of the layers, and the creative gained an understanding of the relative structure of competencies. Using Spearman's correlation analysis, the adequacy of students' approaches to cutting out a background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers and three criteria of creativity (i.e. usefulness, fluency and "specificity") were analyzed in terms of the relationship between them. Spearman's correlation coefficient is a measure of whether there is a relationship between two variables

$$r_s = 1 - \frac{6 \cdot \sum_{i=1}^n (x_i - y_i)^2 + T_A + T_B}{n \cdot (n^2 - 1)} = 1 - \frac{6 \cdot \sum_{i=1}^n d_i^2 + T_D}{n \cdot (n^2 - 1)} \quad (1)$$

and is calculated by the formula, where the number of samples is determined by the formulas under the quantities:  $T_A = \frac{1}{12} \sum (A_j^3 - A_j)$ ,  $T_B = \frac{1}{12} \sum (B_j^3 - B_j)$ ,  $T_D = T_A + T_B$ ,  $d_i = x_i - y_i$ .

The critical value of Spearman's rank correlation coefficient

$$T_{kp} = t_{kp}(\alpha, k) \sqrt{\frac{1-r_s^2}{n-2}} \quad (2)$$

calculated by the formula number of samples in this formula; Spearman's rank correlation coefficient;  $t_{kp}(\alpha; k)$  – dual meaning.

$t_{kp}(\alpha; k)$  – the critical point in the two-sided critical area is found from the Student's critical point distribution table ([34], Appendix 6), in this table the value  $t_{kp}(\alpha; k)$  it depends on the level of values and the number of degrees of freedom .

Table 7 below presents the results of a mathematical and statistical analysis of students' creative competencies according to Spearman's rule in terms of criteria of adequacy and creativity (usefulness, fluency, originality). This table shows the results of calculations at  $n=28$ , the significance level  $\alpha = 0.05$  and  $k=26$ , here according to ([34], Appendix 6) the value is obtained  $t_{kp}(0,05; 26) = 2,06$ .

Table 7

The relationship of various criteria of creativity in determining the creative competence of students

		Adequacy	Utility	Fluency	Originality
Adequacy	Correlation coefficient	1,000	0,873	0,774	0,797
	value	-	0,197	0,256	0,244
Utility	Correlation coefficient	0,873	1,000	0,809	0,785
	value	0,197	-	0,237	0,250
Fluency	Correlation coefficient	0,774	0,809	1,000	0,861
	value	0,256	0,237	-	0,205
Originality	Correlation coefficient	0,797	0,785	0,861	1,000
	value	0,244	0,250	0,205	-
correlation value at 0.05 (two-way)					

As can be seen from the table, adequacy is closely related to utility as one of the criteria of creativity.

Based on three criteria of creativity, between utility and fluency ( $r_s(28) = 0.809$ ,  $p < 0.05$ ), between utility and originality ( $r_s(28) = 0.785$ ,  $p < 0.05$ ) and correlation between fluency and originality ( $r_s(28) = 0.861$ ,  $p < 0.05$ ). It was found that there is a significant relationship between fluency and originality in the performance of students.

In the study of the justification for the assessment of creative competence, including creativity, attention was paid to measuring the creative competence of students according to the criteria of creativity based on the work they performed on the task.

For example, in this task, the approaches of cutting out a background image and placing it on the first layer, drawing an image of a crescent moon and stars on the second layer, writing text on the third layer and combining all layers are classified as good utility, because students used useful approaches only for this task. The fluency of the approaches focuses on the sequence of cutting out the background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers, as well as the completeness and variety of the developed techniques. Almost a third of the students used more ways to complete the task. From the point of view of the originality of the approaches, cutting out the background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and using special techniques to combine all layers, almost half of them were used by most students with second-hand methods.

In general, the results of the assessment of students' performance of tasks on cutting out a creative background picture and placing it on the first layer, drawing an image of a crescent moon and stars on the second layer and writing text on the third layer and combining all layers show that enrichment of creative competence is theoretically desirable, and the enriched system can be evaluated empirically.

Although the students of the 5th grades of the 8th comprehensive school of Navbakhor district had the experience of cutting out a background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers. This is a mid-level assignment when evaluated in terms of creativity.

About 85.7% of students presented adequate approaches to this task, namely "Creating simple images in graphic editors", "Working with text in graphic editors", "Field marking operations in graphic editors" and "With layers" in computer science and information technology. In the information technology classes, "working" topics for students using ICT and the product of their independent learning achieved somewhat better results according to the criteria of fluency and originality in terms of creativity. This indicates that the students tried to try several methods when solving the problem.

The classification of the task into three high-good-medium tasks consists in cutting out the background image and placing it on the first layer, drawing a crescent moon and stars on the second layer and writing text on the third layer, as well as the compatibility of the approaches of combining all layers and the three criteria of creativity are discrete and correlate with the components of creative competence, approximate categories. In addition, instead of the overall assessment of the task, attention was paid to the effectiveness of each component.

Based on the above, the following conclusions can be drawn. According to the analysis of the adequacy of the approaches of combining all layers, there were no special difficulties when performing the given task of cutting and placing the background image provided by the students on the first layer, drawing the image of the crescent moon and stars on the second layer and writing

text on the third layer. Half of the students achieved only a good level of usefulness, which means that they were able to solve the problem on their own. Most of them presented several approaches to solving the task: cutting out the background image and placing it on the first layer, drawing a crescent moon and stars on the second layer, writing text on the third layer and combining all layers. In terms of originality, they completed this task at an average level, i.e. a small number of students presented relatively new approaches.

## CONCLUSION

These results show the adequacy of the approaches of cropping the background image on the first layer, drawing a crescent and stars on the second layer, writing text on the third layer and combining all layers, as well as the correlation between the criteria of creativity, ease or difficulty of the task, and the ratio between the three criteria of creativity shows that it can be secreted. If the task is not too difficult, students can increase the level of usefulness and fluency of approaches.

In general, the study shows that it is possible to evaluate creative competencies based on the criteria of creativity.

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