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DEVELOPING STUDENTS' CREATIVE THINKING THROUGH PROBLEM-BASED TASKS IN TEACHING THE SCIENCE OF DESIGNING TECHNOLOGICAL PROCESSES

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Abstract: This article explores the pedagogical possibilities of developing students' creative thinking in the process of teaching the subject of technological process design. The main focus of the study is on combining problem tasks with the content of the technological design process. Unlike a simple educational task, a problem task is based on the fact that it directs the student not to repeat a ready-made algorithm, but to identify the problem, analyze available information, develop several alternative solutions, compare them based on technological criteria and choose a justified solution. On this basis, a methodological model is proposed consisting of the sequence "understanding the problem - analyzing information - generating ideas - developing alternative technological solutions - substantiating the solution - improving - reflecting". The model links such aspects of creative thinking as fluency, flexibility, originality and improving the idea with technological design activities. The article covers the types of problem tasks, the principles of their development, the mechanism of their application in practical exercises, and the criteria for evaluating creative results.

Keywords: technological process, design, problem-solving task, creative thinking, creativity, technological solution, alternative solution, student, problem-based learning, technological competence.

The complexity of modern technological production processes requires a specialist not only to master existing technological knowledge and practical skills, but also to make independent decisions in new situations, analyze problems and develop alternative solutions. Therefore, one of the important pedagogical tasks is to redirect the teaching process of technological disciplines in higher education from reproductive to problem-based, research and project-based activities. The design of technological processes is one of the disciplines that is close to problem-based activities in its content. Because there may not be a single and unchanging solution in the development of a technological process. The student must consider various options based on existing conditions, resources, time, quality, technical capabilities and production requirements and choose the most appropriate solution from among them.

In engineering education research, creativity is viewed as the process of creative problem solving, including the creation of a new product or solution. A study by Daly, Mosyjowski, and Seifert found that engineering courses are relatively well-equipped with convergent thinking skills related to analysis and evaluation, but that divergent activities related to the generation and open search for ideas are not sufficiently organized [1]. This situation indicates the need for tasks in technological disciplines that allow students to look at the problem from different perspectives and create multiple solutions, rather than just executing a ready-made technological algorithm.

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The issue of creating a new and purposeful result plays an important role in defining the concept of creativity. Runco and Jaeger indicate the combination of novelty and purposefulness as one of the main aspects in describing creativity [2]. Thus, a creative solution in technological design is not limited to being "different"; it must be technologically sound, applicable in existing conditions, and serve a specified purpose.

In Uzbekistan, the issue of developing students' creative thinking in the process of teaching specialized subjects in technical higher educational institutions has become a separate area of scientific research. Mamataliyeva MI's research, published in 2025, is aimed at developing students' creative thinking skills in the teaching of specialized subjects in technical higher educational institutions.

Based on this, this article does not aim to cover all aspects of creativity, but rather to identify **the mechanism for developing creative thinking through problem-based tasks** as the main object of research.

The purpose of the study is to develop a methodological approach aimed at developing students' creative thinking through the use of problem tasks in teaching the science of technological process design and to substantiate its didactic possibilities.

To achieve this goal, the following tasks were set:

– identifying the potential of the science of technological process design to develop creative thinking;

– to reveal the content and pedagogical features of the problem task;

– establishing principles for developing problem tasks for technological design;

– develop stages of developing creative thinking based on problem tasks;

– determining criteria for evaluating students' creative results.

The research used the methods of theoretical analysis of pedagogical and methodological literature, comparative analysis, generalization, modeling, study of the didactic possibilities of problem-based learning and technological design. Methodologically, the research is based on a combination of person-oriented, competency-based, activity-oriented and constructivist approaches. In this case, the student is considered not as a subject who receives ready-made knowledge, but as an active subject who independently analyzes the technological problem, develops solutions and justifies his decision.

The concept of a problematic task and its features in technological design

In a typical learning task, the algorithm for completing the task or the expected answer is usually known in advance. The student uses the information provided to arrive at the result based on the method shown by the teacher.

In a problem-based assignment, the situation itself requires the student to think independently. This may involve multiple solutions to the problem, evaluating solutions based on different criteria, or seeking additional information to complete the assignment.

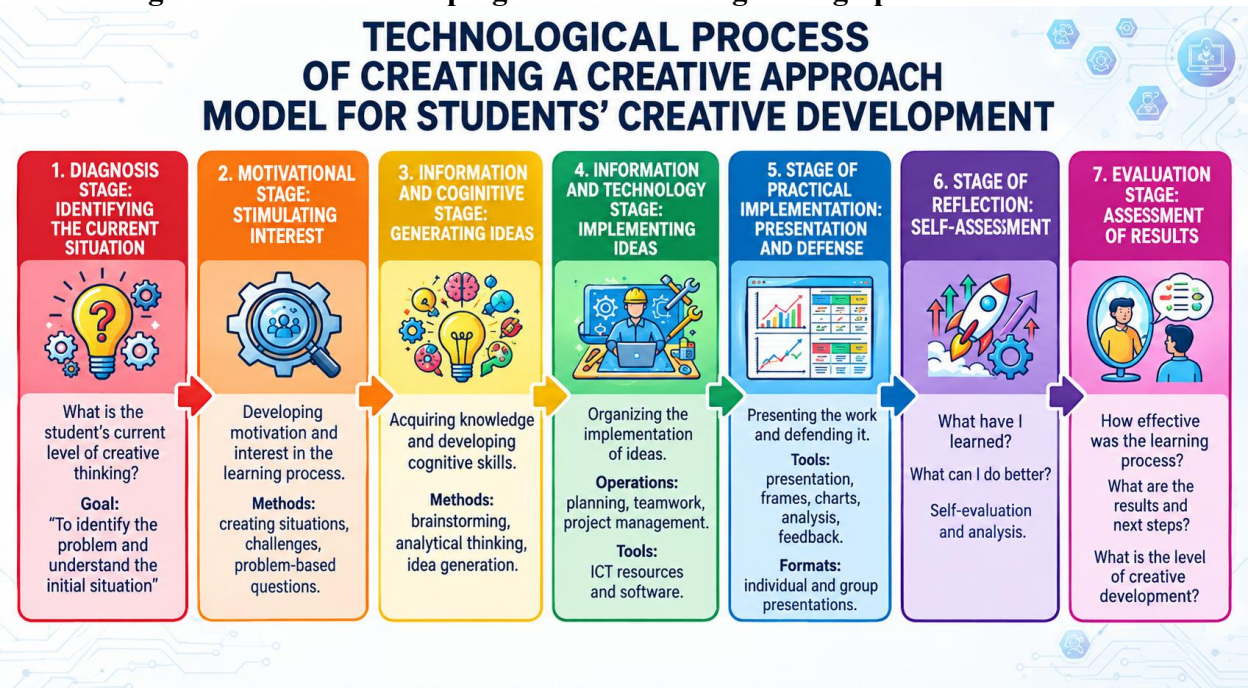
On this basis, a problematic task in the science of technological process design can be defined as follows:

A problem-based task is an educational task that requires the student to apply existing knowledge to a new or changed technological situation, independently identify the problem, develop several alternative solutions, and justify the chosen solution based on technological criteria.

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The main feature of a problem assignment is that its answer is not fully given in advance. The teacher creates the conditions of the problem, but the final technological solution is developed by the student himself.

Methodological model for developing creative thinking through problem-based tasks



The main idea of the proposed model is that the student simultaneously applies technological knowledge and performs creative thinking operations while solving a technological problem.

CRITERIA FOR EVALUATING THE RESULTS OF CREATIVE THINKING

It is not enough to evaluate the effectiveness of a problem-solving task solely by the correctness of the final answer. It is also necessary to take into account how the student arrived at the solution.

T/r	**Criteria**	**Assessment content**
	Fluency of ideas	Number of ideas developed to solve the problem
	Flexibility	Ability to offer solutions in various directions
	Originality	New ideas that differ from standard solutions
	Improvement	Ability to develop the proposed solution
	Technological basis	Compatibility of the solution with technological requirements
	Independent decision	Ability to independently justify the final choice
	Reflection	Being able to analyze one's own thought process

Thus, when assessing creativity, it is appropriate to abandon the binary approach of "the answer is right or wrong" and instead assess it based on **the unity of process and result .**

Pedagogical possibilities of problem tasks

Problem tasks perform several didactic tasks at once in the science of technological process design.

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Firstly, the student applies theoretical knowledge in a real or near-real technological situation. Secondly, he learns to make independent decisions, without being tied to a ready-made algorithm. Thirdly, he has the opportunity to assess in advance the consequences of a technological decision by comparing several solutions.

Research on engineering education has shown that developing creativity involves not only generating ideas, but also developing mechanisms for purposeful organization of creative activity and its evaluation [1].

From this point of view, an important aspect of the proposed methodological model is the organization of creative thinking not as a separate "creative moment" of the lesson, but as **an internal component of the technological design process .**

The analysis shows that, rather than separately organizing special creative exercises to develop creative thinking in the science of technological process design, it is possible to effectively use technological problems inherent in the content of the science itself.

The main change here is not in the form of the assignment, but in its didactic logic. In a traditional assignment:

given information → algorithm → answer

In the problematic assignment, if the sequence is dominant:

The sequence is formed: **problem → research → ideas → alternative solutions → justification → improvement .**

This approach is close to the natural logic of technological design and also expands the student's opportunities for professional development.

Research on technological design in Uzbekistan also shows the importance of competencies such as separation of technological processes, abstraction, generalization of knowledge, and step-by-step planning of the process.

Therefore, the problem assignment can be considered as a didactic tool that connects technological knowledge with creative activity.

The scientific novelty of the research is manifested in the following:

❖Based on the content of the science of technological process design, the pedagogical and didactic content of the problem assignment was clarified.

❖**"problem - analysis - idea - alternative solution - justification - improvement - reflection" model** for developing creative thinking through problem-based tasks was proposed.

❖Types of problem tasks such as technological optimization, creating alternative solutions, error detection, using limited resources, and adapting to new conditions were systematized.

❖It was proposed to combine the criteria of fluency of ideas, flexibility, originality, improvement, technological relevance, and reflection when assessing creative thinking.

Practical importance

The proposed methodological approach can be integrated into practical exercises, independent educational activities, project work and control processes of the discipline “Design of Technological Processes”. Performing problematic tasks in the form of a technological scheme, comparison table, graphic model, digital project or electronic presentation, not limited to a written answer, creates conditions for the development of students' technological thinking, as well as their digital competencies. The use of artificial intelligence and other digital tools in this process should be organized as a tool that

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supports, rather than replaces, the student's independent thinking: they can help in searching for information, expanding ideas, forming alternative options and systematizing information, but the responsibility for choosing the final technological solution, assessing its feasibility and practical justification remains directly with the student.

Conclusion

The development of students' creative thinking in teaching the subject of technological process design requires directing the educational process to problem-based and multi-variant activities, not limiting it to the mastery of ready-made technological algorithms. As a result of the research, the problem task was substantiated as an effective didactic tool that develops students' creative thinking through problem identification, information analysis, development of alternative ideas, comparison of technological solutions, informed decision-making and their improvement. In the proposed methodological model, creativity is considered not as a separate activity from technological design, but as its component, and serves to prepare students of the technological direction for professional activity. In the future, it is advisable to organize experimental and test work on the basis of this methodology, compare the results of the experimental and control groups, and statistically determine the pedagogical effectiveness of the criteria for creative thinking.

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