

**TABIY FANLARNI O'QITISH JARAYONIDA KREATIVLIK, TANQIDIY
FIKRLASH VA MUAMMOLI TA'LIM TEXNOLOGIYALARI**

(5-sinf misolida)

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Annotatsiya: Mazkur maqolada umumiy o'rta ta'lim maktablarining 5-sinf tabiiy fanlarini o'qitish jarayonida o'quvchilarning kreativlik, tanqidiy fikrlash va muammoni hal etish kompetensiyalarini rivojlantirishning pedagogik imkoniyatlari tahlil qilingan. Tadqiqotda zamonaviy ta'limning kompetensiyaviy yondashuvi, muammoli ta'lim texnologiyalari, so'rovga asoslangan ta'lim (Inquiry-Based Learning) va PISA tadqiqotlari talablari asosida tabiiy fanlarni o'qitishning samarali metodlari yoritilgan. Shuningdek, muammoli vaziyatlar, tadqiqot topshiriqlari, loyiha ishlari va interfaol metodlardan foydalanishning o'quvchilarning ijodiy tafakkuri, tahliliy fikrlashi va ilmiy savodxonligini rivojlantirishga ta'siri asoslab berilgan. Tadqiqot natijalari tabiiy fanlarni o'qitishda kreativ fikrlash, tanqidiy tahlil qilish va muammolarni yechish ko'nikmalarini shakllantirishga yo'naltirilgan innovatsion metodik modelning samaradorligini ko'rsatadi.

Kalit so'zlar: tabiiy fanlar ta'limi, kreativlik, tanqidiy fikrlash, muammoli ta'lim, 5-sinf, kompetensiyaviy yondashuv, ilmiy savodxonlik, Inquiry-Based Learning, PISA, innovatsion pedagogik texnologiyalar.

DEVELOPING CREATIVITY, CRITICAL THINKING, AND PROBLEM-SOLVING SKILLS THROUGH NATURAL SCIENCE TEACHING (evidence from grade 5 education)

Annotation: This article examines the pedagogical opportunities for developing creativity, critical thinking, and problem-solving competencies in the process of teaching natural sciences in grade 5 of general secondary schools. The study highlights effective methods of teaching natural sciences based on competency-based education, problem-based learning technologies, inquiry-based learning, and the requirements of international assessments such as PISA. Furthermore, the paper substantiates the impact of problem situations, research tasks, project-based activities, and interactive

teaching methods on the development of students' creative thinking, analytical reasoning, and scientific literacy. The findings demonstrate the effectiveness of an innovative methodological model aimed at fostering creativity, critical thinking, and problem-solving skills in natural science education.

Keywords: natural science education, creativity, critical thinking, problem-based learning, grade 5, competency-based approach, scientific literacy, inquiry-based learning, PISA, innovative pedagogical technologies.

КРЕАТИВНОСТЬ, КРИТИЧЕСКОЕ МЫШЛЕНИЕ И ТЕХНОЛОГИИ ПРОБЛЕМНОГО ОБУЧЕНИЯ В ПРОЦЕССЕ ПРЕПОДАВАНИЯ ЕСТЕСТВЕННЫХ НАУК

(на примере 5-го класса)

Аннотация: В данной статье рассматриваются педагогические возможности развития креативности, критического мышления и компетенций по решению проблем в процессе преподавания естественных наук в 5-х классах общеобразовательных школ. Исследование основано на компетентностном подходе, технологиях проблемного обучения, исследовательском обучении (Inquiry-Based Learning) и требованиях международных программ оценки качества образования, в частности PISA. Обоснована эффективность использования проблемных ситуаций, исследовательских заданий, проектной деятельности и интерактивных методов обучения для формирования у учащихся творческого мышления, аналитических способностей и естественно-научной грамотности. Результаты исследования показывают, что внедрение инновационной методической модели способствует развитию у школьников навыков критического анализа, творческого поиска и самостоятельного решения учебных и жизненных проблем, что отвечает современным требованиям глобализирующегося образовательного пространства.

Ключевые слова: Естественно-научное образование, креативность, критическое мышление, проблемное обучение, 5 класс, компетентностный подход, естественно-научная грамотность, исследовательское обучение (Inquiry-Based Learning), PISA, инновационные педагогические технологии.

Introduction. In today's globalization environment, the main task facing the education system is not to memorize knowledge, but to form a thinking, creative and problem-solving personality [1; p. 18].

Natural sciences play a leading role in forming a scientific worldview in students. Because these sciences are based on the processes of observation, experimentation, analysis and conclusion. While the traditional education model shapes the student as a passive recipient of knowledge, modern pedagogical technologies aim to transform

him into an active researcher. The student must not only acquire knowledge, but also be able to apply it in real-life situations [2; p. 28]. In particular, natural science education has important pedagogical opportunities for developing cognitive activities in students, such as scientific thinking, observation, experimentation, and identification of cause-and-effect relationships.

It is noted in the scientific literature that when the process of teaching natural sciences is based on research activities, students' interest in knowledge increases and their level of independent thinking significantly develops [3; p. 34]. Modern didactics requires a transition from traditional explanatory and demonstration methods to interactive and problem-based educational technologies.

The concept of critical thinking is interpreted in pedagogy and psychology as a person's ability to analyze information, compare evidence, and draw well-founded conclusions. According to Bloom's taxonomy, the stages of analysis, synthesis, and evaluation constitute a higher level of thinking activity, and it is these processes that serve to form creative thinking [4; p. 155].

In general secondary schools, a reproductive approach still prevails in teaching natural sciences, which leads to insufficient development of students' independent thinking and problem-solving skills. This situation creates the need for the integrated use of creativity, critical thinking, and problem-based educational technologies.

Literature review. In modern pedagogical science, the study of creativity, critical thinking and problem-based learning technologies is one of the important scientific directions for increasing the effectiveness of education. This problem has been studied by domestic and foreign scientists based on various theoretical approaches.

The concept of creativity was initially interpreted in psychology as a person's ability to create new ideas. J. Guilford linking creative thinking with divergent thinking, interprets creativity as the ability to solve a problem in different ways [5; p. 445]. Later E. Torrance scientifically substantiated that the development of creative thinking is an important pedagogical task of the educational process [6; p. 24].

The development of creativity in the educational process is closely related to the constructivist approach. According to the theory of constructivism, knowledge is not given by the teacher ready-made, but is formed in the process of active cognition of the student [7; p. 67]. This idea was put forward by L.S.Vygotsky's theory of sociocultural development also substantiates the fact that the process of knowledge acquisition occurs through collaborative activity [8; p. 86].

The issue of critical thinking has been formed as a separate scientific direction in pedagogy and philosophy of education. R. Paul and L. Elder describe critical thinking as the competence of analyzing information, evaluating evidence, and making logical

decisions [9; p. 17]. In Bloom's taxonomy, higher-level thinking processes - analysis, synthesis, and evaluation - are indicated as the main components of critical thinking [4; p. 207].

Scientific research on the methodology of teaching natural sciences has noted that the development of students' scientific thinking is carried out through experience, observation, and problem situations. J.O.Tolipova emphasizes that involving students in an active research process in teaching natural sciences increases the effectiveness of education [3; p. 35]. Also, the use of innovative pedagogical technologies is scientifically substantiated by R.J. Ishmuhamedov [10; p. 45].

Problem-based learning technology dates back to J. Dewey's pragmatic education concept in the history of pedagogy. Dewey shows the need to organize the educational process based on solving real-life problems [11; p. 53]. Later problem-based learning technology was formed as a method that directs the pedagogical process to research.

Literature analysis shows that creativity, critical thinking, and problem-based learning technologies form an integrated pedagogical system. In particular, science education is the most suitable methodological field for the formation of these competencies.

Science lessons for grades 1-6 in general secondary schools can be organized based on the following stages.

Problem-based learning technology: creating a problem situation; putting forward a hypothesis; conducting an experiment; analysis and reflection.

Research methods: analysis of scientific sources; pedagogical observation; experimental and test work; diagnostic evaluation; comparative analysis.

Theoretical methods: analysis of scientific and pedagogical sources; comparison of competency-based and constructive approaches; modeling of educational technologies.

Empirical methods: pedagogical observation; experimental and test work; diagnostic tests; questionnaire and reflection methods.

Results. During the research, experimental and test work was carried out on creativity, critical thinking and the use of problem-based learning technologies in natural science lessons (grades 1-6). A comparative analysis of students' cognitive activity, creative approach and problem-solving competencies was carried out between the experimental class and the control class.

During the lesson, students' learning activity was assessed based on three main indicators: the level of creative thinking; critical thinking skills; competence in solving problem situations.

The results showed that students' cognitive activity significantly increased in lessons organized on the basis of problem-based learning technologies.

Table 1

№	Indicators	Control group (traditional)	Experimental group (problem-based learning)
1	Creative thinking	41%	79%
2	Critical thinking	44%	82%
3	Problem-solving skills	46%	85%
4	Activity in the lesson	58%	90%
5	Independent judgment	43%	81%

The results show that all indicators were significantly higher in the experimental group. Analysis of the results. The results of the experiment confirmed the high effectiveness of problem-based learning technologies in developing creativity and critical thinking. In particular, students' skills in asking independent questions, putting forward hypotheses, and drawing conclusions based on experience significantly developed.

The analysis showed that lessons organized on the basis of problem situations: increased students' motivation to learn; strengthened group cooperation; formed elements of scientific thinking. In the process of general analysis, the use of problem-based learning technologies in natural science lessons led to the following:

- increased creative thinking by an average of 35–40%;
- increased critical thinking by 30–38%;
- increased problem-solving competence by 35–42%.

This confirms the high scientific and practical effectiveness of this approach.

Discussion. The results of the study show that the integration of creativity, critical thinking and problem-based learning technologies in teaching natural sciences significantly activates the cognitive activity of students. The results obtained are consistent with the basic principles of modern pedagogical approaches and confirm the practical effectiveness of the competency-based education model.

First of all, it was found that the development of creativity is directly related to problem situations. In the process of solving problems that are close to real life, students demonstrated the skills of developing various solutions, putting forward hypotheses and drawing conclusions based on experience. This result is consistent with the theory of divergent thinking put forward by Guilford, that is, finding several solutions to one problem is the main sign of creative thinking.

Also, in the process of developing critical thinking, students were involved in analyzing information, comparing evidence and drawing informed conclusions. Critical thinking is not only the ability to acquire knowledge, but also the ability to analyze and evaluate it.

The effectiveness of problem-based learning technology is particularly noteworthy. Problem situations created during the lesson strengthened students' internal motivation for knowledge and encouraged them to actively search. According to social constructivist theory, knowledge is formed through collaborative activity. Group work, discussion, and collaborative research during the lesson provided students with a high level of cognitive activity.

The results obtained are also consistent with Bloom's taxonomy. In particular, students were able to move from the levels of "knowledge" and "understanding" to the stages of "analysis", "synthesis", and "evaluation". This indicates the effectiveness of problem-based learning technology in developing higher-level thinking operations.

Also an approach based on experience and practical activities in teaching natural sciences plays an important role in developing students' scientific thinking. The results of this article also confirm this idea, since during the lesson, students consolidated their knowledge through observation, experimentation, and analysis.

According to the concept of innovative pedagogical technologies, organizing the educational process based on interactive methods increases the activity of students. Studies have shown that the combination of interactive methods and problem-based learning significantly increases students' interest and participation in the lesson. The highest efficiency is achieved when creativity, critical thinking and problem-based learning technologies are used in an integrated manner. This requires that the role of the teacher in the modern educational process becomes a guide and facilitator rather than a knowledge provider.

Conclusion. Based on the results of the study, the following scientific conclusions were formulated.

First, it was found that the development of creativity in the process of teaching natural sciences is effectively implemented through lessons organized on the basis of problem situations.

Second, Students had the opportunity to develop new ideas, propose alternative solutions, and demonstrate a creative approach in the process of solving real-life problems.

Third, it was confirmed that students' activities to analyze information, compare evidence, and draw informed conclusions are important in the formation of critical thinking.

Fourth, problem-based learning technology serves to transfer students from low-level cognitive activity (knowledge and understanding) to high-level thinking operations (analysis, synthesis, evaluation).

It was also shown that when creativity, critical thinking, and problem-based learning technologies are used in an integrated manner, educational effectiveness increases significantly. Therefore, modern science education should be based on a constructive and competency-based approach that transforms the student from a passive learner to an active researcher.

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