Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 05, May, 2025
brightmindpublishing.com
ISSN (E): 3061-6964

METHODOLOGY OF USING INNOVATIVE APPROACHES IN DEVELOPING MATHEMATICAL CREATIVITY OF HIGH SCHOOL STUDENTS

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Abstract
This article scientifically reveals educational methods aimed at developing mathematical creativity of high school students in the process of teaching mathematics and their effectiveness.

Keywords: Mathematical creativity, Interactive approach, ensuring freedom of thought, encouraging participation, effective use, participatory and motivating, Interactive whiteboard, GeoGebra or Desmos.

Introduction

Interactive methods in modern education are methodological tools that allow not only to revitalize education, but also to build the process of knowledge acquisition on the basis of active cooperation, critical approach and creative thinking. However, for the effective use of these methods, certain pedagogical conditions and organizational mechanisms must be properly established.

Problems based on problem situations are of great importance in the formation of creativity. To increase the student's ability to think, problems should be presented not only in a standard form, but also in a form with a different approach.

Example 1: 16 trees are planted in a square garden. The distance between the trees is the same everywhere. How many straight lines can be drawn?

Creative approach: A 4x4 table has vertical, horizontal, diagonal and other lines. Through this, the student develops the ability to think spatially and reason.

Example 2: In how many ways can you get from top to bottom in a 3x3 table, moving only to the right and down?

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Solution: This involves 3 moves down (D) and 3 moves right (R). Total number of paths: C(6,3) = 20.

Example 3: Find a way to divide the numbers 1 to 9 into 3 3-digit numbers using only one number, and minimize their sum.

Creative approach: This requires taking into account the balance and order between the numbers, which encourages students to think.

Necessary conditions for the effective use of interactive methods

Interactive methods, especially in mathematics, serve to form creative thinking, analytical approach and communication-based competencies. However, to achieve this result, it is important to adhere to the following didactic conditions:

1. Ensuring freedom of thought for students

The key to the success of interactive methods is the creation of an environment of freedom of thought and psychological safety. Students should be able to freely express their ideas without fear of criticism. Any idea - whether right or wrong - is considered a value that contributes to creative thinking.

2. Encourage the participation of each student

Interactive lessons should serve to ensure the active participation of each student, not only active students. To do this:

• Rotate roles;

• Assign different tasks to group members (for example: leader, presenter, questioner);

• It is recommended to evaluate student participation with positive encouragement.

3. Ask open-ended questions for discussion

Open-ended questions are questions that are not limited to “Yes/No”, but require thinking, guessing, reasoning, and comparing. They activate the student’s thinking stages at the levels of analysis, synthesis, and evaluation.

For example:

“Can this equation be solved in another way?”

“What kind of graph will result if we depict this formula in a visual form?”

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4. The teacher's role is that of a participant and motivator, not a controller

In interactive methods, the teacher plays the role of a participant in the dialogue and a person who guides the process.

This pedagogical position:

• Creates an environment for students to learn "through understanding, not instruction";
• Encourages "deepening of thought" instead of evaluating each idea;
• The teacher enlivens the learning process with creative questions and ideas.

5. Use of technological tools (interactive whiteboards, online platforms)

Interactive methods give maximum results only when combined with information and communication technologies. For example:
• Create group clusters using an interactive whiteboard;
• Visually analyze equations using graphical applications such as GeoGebra or Desmos;
• Share ideas in real time on online platforms (Padlet, Jamboard, Quizizz, Kahoot).

1. Results of interactive methods based on experience and research
2. Pedagogical research and pilot tests conducted in different countries and national contexts have proven the high impact of interactive methods.
3. Scientific results and observations:

o Deeper understanding of mathematical concepts:
o Students taught through an interactive approach mastered complex concepts through analysis, not just memorization.
o For example, those who learned the topic of "function" by "reading," "forming," and "realistic modeling" the graph achieved higher results than those who learned it by "drawing" graphs.

4. Logical consistency and creative approach are formed:

o Through question-and-answer, cluster, and discussion methods, students abandon one-sidedness in reaching a solution and develop alternative approaches.

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5. The ability to think independently and propose alternative solutions increases:

o For example, for the "quadratic equation", not only based on the formula, but also on the development of various solutions based on a graphic, inverse problem, or real example was observed.

6. Communication and teamwork skills are developed:

o In group activities, students become more active in skills such as expressing their opinions, listening, accepting opposing views, and making presentations;

o This increases not only their knowledge, but also their creative communication potential.

The effective use of interactive methods is not only related to the choice of method, but also to the correct organization of the mechanism for its implementation. Freedom of thought, open-ended questions, the motivating role of the teacher, the participation of each student, and the proper integration of technology are all key factors in developing mathematical creativity through interactive methods.

Experience shows that students who learn through interactive methods not only gain solid knowledge, but also:

- Independent thinking,
- Creating new ideas,
- Working in a group,
- Logical consistency,
- Analytical and synthesis skills are also acquired.

Therefore, interactive methods are not only a teaching tool, but also a strategy for forming a creative personality.

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