

RESEARCH ARTICLE

# Organizing Problem-Based Learning Using Artificial Intelligence Tools and Developing Students' Critical Thinking

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## Abstract

The article analyzes the pedagogical possibilities of organizing problem-based learning through the use of artificial intelligence tools and developing students' critical thinking skills. It examines the didactic possibilities of using artificial intelligence technologies in the modern digital educational environment, including their role in creating problem situations, identifying problems, formulating questions, searching for and analyzing information, comparing different viewpoints, and drawing well-founded conclusions. The study develops a methodological model based on the integration of problem-based learning, critical thinking, and artificial intelligence. In this model, artificial intelligence is considered not as a source of ready-made knowledge, but as a pedagogical tool that facilitates students' independent thinking and problem-solving activities.

## KEY WORDS

Artificial intelligence, problem-based learning, critical thinking, digital education, pedagogical technology, problem situation, independent thinking, information literacy, reflection, learner.

## INTRODUCTION

Attention to the issue of introducing artificial intelligence technologies into the educational process is increasing in the education system of Uzbekistan. Local studies analyze the possibilities of artificial intelligence for personalizing education, supporting learning activities, and improving educational effectiveness. For example, a study conducted by Baydullaev, Tayrov, and Serikova presents the role of artificial intelligence in modern education, its possibilities, and existing challenges [1].

The main feature of problem-based learning is that it transforms the learner from a recipient of ready-made knowledge into an active participant in the process of understanding a problem, identifying its causes, analyzing available information, and seeking a solution.

This aspect of problem-based learning is directly connected with the development of critical thinking. In one of the studies conducted in the Karakalpakstan region, U. Bekmuratova demonstrated the importance of problem-based learning methods in developing independent thinking, critical thinking, creative thinking, and communication skills. The study emphasizes that effective organization of problem-based learning is also associated with the teacher's methodological preparedness, educational infrastructure, and learners' preparedness [2].

Thus, in problem-based learning, the main focus is not on providing a ready-made answer, but on the process of recognizing a problem, asking questions, seeking evidence, evaluating it, and making a well-founded decision.

Critical thinking is the ability not merely to receive information, but to analyze it, evaluate evidence, identify causes and consequences, compare different viewpoints, and draw logical conclusions. Richard Paul and Linda Elder associate critical thinking with the continuous analysis and improvement of the thinking process [3].

Local pedagogical studies also regard the development of critical thinking as one of the important areas of research. In particular, problem-based tasks, discussion, question-and-answer activities, and independent inquiry can contribute to increasing students' thinking activity.

The recommendations developed by UNESCO on the possibilities of artificial intelligence in education also emphasize human-centered engagement, pedagogical appropriateness, verification of information reliability, and academic integrity [4].

Therefore, the primary purpose of using artificial intelligence should not be to provide students with ready-made answers, but to encourage them to ask questions, identify problems, verify evidence, and arrive at independent conclusions.

### **Research objective**

The main objective of the study is to identify the pedagogical and methodological possibilities of developing students' critical thinking skills through the organization of problem-based learning using artificial intelligence tools and to develop an effective methodological model.

Based on this objective, the following tasks were identified:

1. To examine the theoretical foundations of problem-based learning and critical thinking.
2. To identify the didactic possibilities of artificial intelligence in the educational process.
3. To substantiate the possibilities of integrating problem-

based learning and AI technologies.

4. To develop a system of tasks aimed at developing students' critical thinking skills.
5. To determine the pedagogical conditions for using AI tools.
6. To develop methodological recommendations aimed at developing students' skills in verifying and evaluating information.

### **METHODS**

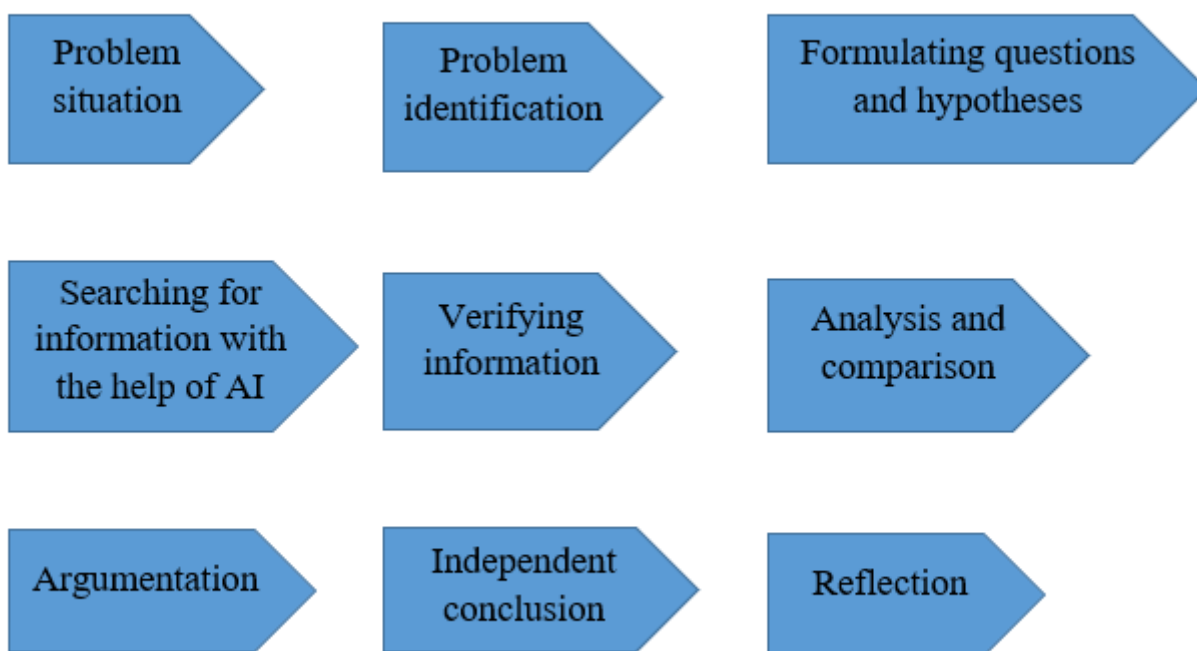
The study employed theoretical and practical methods to identify the pedagogical possibilities of problem-based learning and artificial intelligence technologies for developing students' critical thinking.

The main methods included:

- ❖ analysis of scientific and pedagogical literature;
- ❖ comparative analysis
- ❖ pedagogical observation
- ❖ modeling of problem situation
- ❖ question-and-answer
- ❖ problem-based tasks
- ❖ analysis of students' activities
- ❖ reflexive assessment
- ❖ generalization of results.

In the research methodology, the artificial intelligence tool was considered not as a source of ready-made answers, but as a pedagogical tool that assists in organizing problem-based learning.

The conceptual model of the study was based on the following sequence:



An important feature of this model is that AI does not replace the student's thinking process. The student first forms their own opinion and then uses the AI tool to seek additional information, viewpoints, and alternative solutions.

#### **INTEGRATION OF PROBLEM-BASED LEARNING AND ARTIFICIAL INTELLIGENCE**

The essence of problem-based learning is not to provide the learner or student with ready-made knowledge, but to place a specific problem before them in the learning process and guide them toward solving that problem independently.

Artificial intelligence can serve as an additional intellectual tool in such a process. For example, a teacher may pose the following problem-based question to students:

"Does artificial intelligence improve the quality of education, or can it have a negative effect on students' independent thinking?"

Students first express their initial hypotheses in response to this question. Then, with the help of AI, they identify different viewpoints on the issue.

Students are given the following tasks:

- ✓ Identify the main ideas in the answer provided by AI

- ✓ Find evidence for each idea
- ✓ Verify the reliability of the evidence
- ✓ Compare it with other scientific sources
- ✓ Identify opposing viewpoints
- ✓ Formulate their own position
- ✓ Write the concluding statement independently.

Thus, it is not the act of working with AI itself, but the critical reprocessing of the information provided by AI that becomes the main process for developing critical thinking.

#### **RESULTS**

The research results show that purposeful use of artificial intelligence tools can increase the interactivity of problem-based learning and accelerate students' thinking activities.

In a problem-based learning process organized on the basis of artificial intelligence, the student simultaneously performs several types of activity:

1. Identifies the problem
2. Asks questions
3. Puts forward a hypothesis
4. Searches for information

5. Interacts with AI
6. Analyzes the answers obtained
7. Verifies evidence
8. Compares different viewpoints
9. Develops alternative solutions
10. Draws an independent conclusion
11. Reflexively evaluates their own activity

**Table 1. The impact of AI-based problem-based learning on critical thinking.**

| <b>Stage of problem-based learning</b> | <b>Use of the AI tool</b>                                    | <b>Skill developed</b>       |
|----------------------------------------|--------------------------------------------------------------|------------------------------|
| 1. Posing the problem                  | Formulating problem-based questions, identifying the problem | Problem-identification skill |
| 2. Discussing the problem              | Obtaining different viewpoints                               | Analytical thinking          |
| 3. Searching for information           | Obtaining initial information with the help of AI            | Information-search skill     |
| 4. Evaluating information              | Comparing the answers obtained with other sources            | Critical evaluation          |
| 5. Identifying evidence                | Distinguishing evidence and counter-evidence                 | Logical thinking             |
| 6. Decision-making                     | Developing alternative solutions                             | Problem-solving skill        |
| 7. Drawing a conclusion                | Systematizing and generalizing evidence                      | Independent thinking         |
| 8. Reflection                          | Analyzing and evaluating one's own activity                  | Metacognitive skill          |

### **Developing Students' Critical Thinking When Working with AI**

Simply asking questions is not sufficient for a student while working with AI. The student must also evaluate the quality of the answer obtained.

For this purpose, the following system of questions may be used:

1. What evidence is this idea based on?
2. Which source confirms this information?
3. Could there be an error in the answer provided by AI?
4. What evidence exists against this idea?
5. How do other scholars view this issue?
6. Which viewpoint is more strongly supported by scientific evidence?
7. How can the AI answer be verified?
8. What is my conclusion?

These questions help students develop not as ordinary

consumers of information, but as active subjects who analyze and evaluate information.

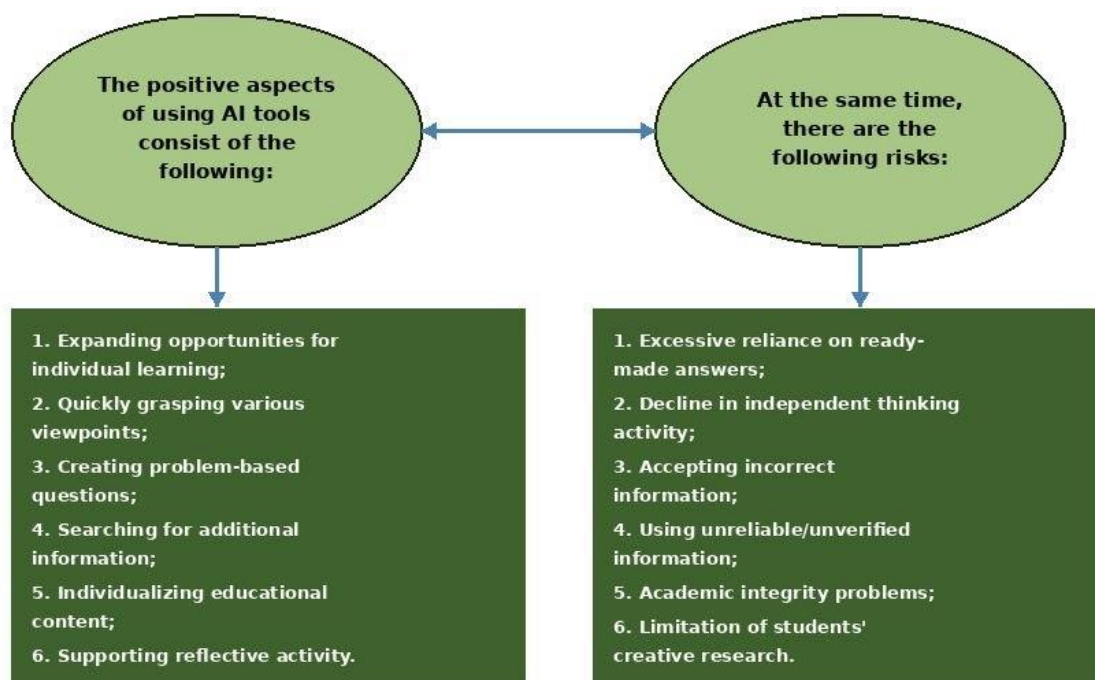
## DISCUSSION

The results obtained demonstrate that the use of artificial intelligence tools can enrich the content of problem-based learning. However, the mere presence of AI technology does not by itself guarantee the development of critical thinking.

Local studies also show that the effectiveness of problem-based learning depends on the teacher's methodological

preparedness and the proper organization of the educational process. In U. Bekmuratova's study, teacher preparedness, educational infrastructure, and learner preparedness are identified as important factors in implementing problem-based learning [2].

This situation directly applies to AI-based education as well. In other words, it is not the mere availability of technology, but the methodological purpose for which it is used that determines the educational outcome.



Therefore, when working with AI, it is advisable for the teacher to apply the principle of "verification-comparison-analysis-conclusion."

## CRITERIA FOR ASSESSING STUDENTS' CRITICAL

## THINKING.

In an AI-based problem-based learning process, assessment should be directed not only at the final answer but also at the thinking process.

| Criterion                     | Low level                             | Medium level                          | High level                                                  |
|-------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------------------------|
| <b>Problem identification</b> | Does not fully understand the problem | Identifies the problem to some extent | Identifies the problem clearly and in a well-founded manner |
| <b>Information search</b>     | Accepts ready-made information        | Uses several sources                  | Purposefully searches for and compares sources              |
| <b>Information</b>            | Accepts                               | Partially verifies                    | Critically evaluates sources                                |

|                             |                                       |                                              |                                                                           |
|-----------------------------|---------------------------------------|----------------------------------------------|---------------------------------------------------------------------------|
| <b>evaluation</b>           | information without verification      | information                                  | and evidence                                                              |
| <b>Argumentation</b>        | Cannot substantiate their own opinion | Provides some evidence                       | Substantiates their own opinion with strong evidence                      |
| <b>Alternative solution</b> | Limits themselves to one solution     | Proposes several solutions                   | Analyzes alternative solutions and substantiates the most appropriate one |
| <b>Drawing a conclusion</b> | Repeats a ready-made answer           | Draws a partially independent conclusion     | Draws an independent and logical conclusion                               |
| <b>Reflection</b>           | Cannot evaluate their own activity    | Evaluates some aspects of their own activity | Analyzes their thinking process in depth                                  |

### The Role of the Teacher

AI-based problem-based learning also changes the role of the teacher. The teacher is not merely a provider of information, but rather:

1. a designer of problem situations;
2. a developer of problem-based questions;
3. an organizer of the process of working with it;
4. a verifier of information reliability;
5. a manager of students' thinking processes;
6. an organizer of reflection;
7. a facilitator who guides students toward drawing independent conclusions.

From this perspective, the modern teacher requires not only digital competence, but also an integrated combination of pedagogical, methodological, informational, and critical-thinking competencies.

### CONCLUSION

In conclusion, organizing problem-based learning through the use of artificial intelligence tools is considered one of the

promising pedagogical opportunities for developing students' critical thinking skills.

The research results show that purposeful use of AI technologies makes it possible to create problem situations, formulate questions, obtain different viewpoints, search for information, compare evidence, develop alternative solutions, and organize reflection.

However, AI should not be turned into a tool that simply provides ready-made answers in the educational process. Its primary pedagogical function should be to support students' independent thinking, questioning, verification of information, evaluation of evidence, and arrival at well-founded conclusions.

Studies by scholars in Uzbekistan and Karakalpakstan also demonstrate the importance of problem-based learning, independent thinking, critical thinking, and the use of digital technologies. In particular, U. Bekmuratova's study substantiates the importance of problem-based learning in developing independent, critical, and creative thinking [2].

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