INTEGRATING THE 5E INSTRUCTIONAL MODEL AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES TO DEVELOP PRIMARY SCHOOL STUDENTS' CREATIVE ABILITIES

Shoyeva Yulduz Amin qizi
Independent Researcher at Bukhara State Pedagogical Institute, Lecturer at the Department of Primary Education, Faculty of Preschool and Primary Education

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Abstract. *The integration of artificial intelligence (AI) technologies into primary education creates new opportunities for developing students' creative abilities, independent thinking, problem-solving skills, and inquiry-based learning. This paper explores the pedagogical potential of combining the 5E Instructional Model with AI-supported educational resources.*

Keywords: *5E Instructional Model, artificial intelligence, primary education, creative abilities, creative thinking, digital learning resources, inquiry-based learning, natural science education.*

The rapid development of digital technologies and artificial intelligence has significantly influenced contemporary educational practices. Modern education increasingly requires learning environments that encourage students not only to acquire knowledge but also to develop creative thinking, independent decision-making, inquiry skills, and the ability to generate original ideas. These competencies are particularly important in primary education, where the foundations of cognitive development, curiosity, imagination, and creative activity are established.

In this context, the integration of artificial intelligence technologies into the teaching and learning process offers new pedagogical opportunities. AI-based educational tools can support the visualization of complex concepts, generate problem-based questions, provide differentiated learning materials, and encourage students to explore alternative solutions. However, the educational effectiveness of these technologies depends on their purposeful integration into a scientifically grounded instructional framework.

One such framework is the 5E Instructional Model, which consists of five interconnected stages: Engage, Explore, Explain, Elaborate, and Evaluate. Developed within the framework of the Biological Sciences Curriculum Study (BSCS), the model is based on constructivist principles and emphasizes active student participation in knowledge construction (Bybee et al., 2006).

The integration of AI technologies with the 5E model can create an interactive and student-centered learning environment in which learners investigate problems, formulate hypotheses, construct explanations, develop creative products, and evaluate their own learning outcomes.

The purpose of this paper is to identify the pedagogical opportunities and methodological approaches for integrating artificial intelligence technologies into the five stages of the 5E model to develop primary school students' creative abilities, particularly in natural science education.

The research is based on theoretical analysis, comparative analysis, pedagogical synthesis, and methodological design. Scientific publications concerning the 5E Instructional Model, artificial intelligence in education, constructivist learning, and creativity development were examined to identify the possibilities of integrating AI-supported resources into primary education.

The proposed integration framework combines the instructional functions of the 5E model with the supportive capabilities of AI technologies. AI-generated questions, visual materials, interactive simulations, digital assistants, and formative assessment tools are considered supplementary resources rather than independent sources of knowledge.

The theoretical and methodological analysis indicates that integrating AI technologies into the 5E Instructional Model can provide opportunities for organizing differentiated, interactive, and inquiry-oriented learning activities. Each stage of the model can be enhanced through the purposeful use of AI-supported educational resources.

1. Engage – Stimulating curiosity and creative thinking

At this stage, AI technologies can be used to generate problem-based questions, educational illustrations, and unusual scientific situations. For example, students studying living and non-living nature can analyze AI-generated images, classify objects, and answer questions such as: "What would happen if plants could not receive sunlight?" Such activities stimulate curiosity, questioning, and original thinking.

2. Explore – Developing inquiry and independent investigation

AI-supported simulations, interactive models, and inquiry tasks enable students to investigate natural phenomena, compare information, and formulate hypotheses. For example, students can explore how sunlight, water, and temperature affect plant growth. Direct observation and independent reasoning remain essential.

3. Explain – Constructing and communicating knowledge

AI tools can support students in explaining scientific concepts through visual materials, concept maps, and digital presentations. Students interpret investigation results and formulate conclusions, while AI-generated information is verified through textbooks and reliable scientific sources.

4. Elaborate – Expanding knowledge and producing creative solutions

At this stage, AI supports creative projects, digital design, and the development of alternative solutions. For example, students can design an environmentally friendly school or a sustainable city using AI-generated visual ideas as inspiration. This develops originality, flexibility, and creative problem-solving.

5. Evaluate – Assessing creative development and learning outcomes

AI-supported quizzes, differentiated tasks, and formative feedback can help assess students' learning outcomes. Creative projects, presentations, and inquiry reports are evaluated according to criteria such as fluency, flexibility, originality, and elaboration.

The following criteria are proposed for assessing creative abilities:

1. Ability to generate several ideas and possible solutions.

2. Ability to approach a problem from different perspectives.
3. Ability to propose original ideas and independent solutions.
4. Ability to develop and improve creative products.
5. Ability to justify decisions using acquired knowledge.

Thus, assessment should focus not only on the correctness of answers but also on the process of creative thinking, independent activity, and the quality of students' proposed solutions.

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