



EFFECTIVENESS OF APPLYING THE 5E MODEL IN TEACHING NATURAL SCIENCES IN PRIMARY EDUCATION

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Abstract

This article highlights the scientific and theoretical foundations and practical advantages of organizing natural science lessons in primary grades based on the 5E model (attraction, research, explanation, expansion, and assessment). The model serves as an effective tool for the development of students' scientific thinking, ensuring their active participation.

Keywords: 5E model, primary education, science, interactive method, student activity.

Introduction

The main goal of the modern education system is the formation in students of such competencies as independent thinking, finding solutions in problem situations, and making scientifically based decisions. This is especially important at the stage of primary education, because during this period the child not only acquires knowledge, but also masters elements of mental activity, such as thinking, analysis, synthesis. Therefore, teachers, using modern pedagogical technologies and methods, should create an activity-based learning environment centered on students.

Natural sciences are one of the most important components of primary education. Because through these subjects, the student acquires the first scientific ideas about existence, observes natural phenomena, conducts experiments, and learns to draw conclusions. In traditional lessons, this process is often based on the teacher's monologue, and the student is forced to memorize the ready-made knowledge. This does not meet the requirements of modern education.



In these conditions, the 5E model acquires special significance due to its systematic and step-by-step approach. This model was developed by the US scientific center **BSCS (Biological Sciences Curriculum Study)**, which proposes to organize the educational process based on five important stages: **Engage (involvement), Explore (exploration), Explain (explanation), Elaborate (extension), Evaluate (evaluation)**. Each stage is characterized by its student orientation: the student enters the center of activity, searches, asks questions, independently identifies concepts, and analyzes their knowledge.

The 5E model fully corresponds to constructive pedagogical approaches. As modern pedagogical psychologists **J. Piaget** and **L.S. Vygotsky** emphasize, when a child acquires knowledge not in a ready-made form, but through their own active research, this knowledge becomes deeper and more lasting. The 5E model provides exactly this process.

According to **UNESCO**, in lessons using interactive and student-centered methods, the learning outcomes are **30-40% higher**. In addition, the **Concept for the Development of Education** of the Republic of Uzbekistan for **2022-2026** also defines the phased implementation of interactive and competency-based approaches in education as a key task.

So, the application of the 5E model in teaching natural sciences in primary education:

- Increases students' interest in the subject;
- Develops skills of independent observation and drawing conclusions;
- Combines theory and practice;
- Ensures interdisciplinary connectivity;
- Engages students in the lesson as active participants.

This article analyzes the theoretical foundations of the 5E model, its practical application in teaching natural sciences, the results achieved during the lesson, and teacher observations. The article serves to develop scientific and theoretical foundations and practical recommendations for the application of interactive methods in primary education.

LITERATURE ANALYSIS AND METHODS

This study was carried out in stages and used methods of qualitative (qualitative) and quantitative (quantitative) analysis. To determine the effectiveness of

organizing natural science lessons in primary education based on the 5E model, the following methods were selected:

Scientific articles, textbooks, and methodological manuals on the 5E model, the constructive educational approach, and methods of teaching natural sciences in primary education were studied. In particular, the conceptual foundations of the 5E model developed by R. Bybee, the recommendations of UNESCO and BSCS (Biological Sciences Curriculum Study) organizations were analyzed.

In the 2024-2025 academic year, natural science lessons were observed in grades 2-4 of general education schools in the Khorezm region. Classes were organized in two groups:

- **Control group** - Traditional lessons;
- **Experimental group** - planned lessons based on all stages of the 5E model.

During each lesson, the level of student activity, the ability to answer questions, participation in experiments, and the results of the final assessment were observed. A survey was conducted among primary school teachers, students, and their parents. The survey questions were aimed at:

- ✓ Change in student participation in lessons based on the 5E model;
- ✓ Level of interest in subjects;
- ✓ The ability to apply the knowledge gained in the lesson in real life;
- ✓ Parents' opinions about the changes observed in their children.

Interviews were also conducted with teachers who conducted experimental lessons, and based on their opinions, the practical advantages and disadvantages of the model were analyzed.

With the experimental group, based on the 5E model, **5 lesson plans** were created and conducted. Lesson topics were selected in accordance with the State Educational Standards for grades 2-4. Each lesson was conducted in the following stages:

- 1. Engage** - attract the reader's attention through questions, problem situations, pictures, or videos.
- 2. Explore** - conducting experiments, observation, and data collection in groups.
- 3. Explanation (Explain)** - discussion of students' findings, clarification of concepts.
- 4. Expansion (Elaborate)** - application of acquired knowledge in new situations.

5. Evaluate (Evaluate) - mutual assessment, feedback from the teacher, assessment of knowledge through tests or written assignments.

At the end of the lesson, the level of students' knowledge was measured using specially prepared tests and compared with the results of the control group.

RESULTS AND DISCUSSION

During the study, it was established that natural science lessons organized on the basis of the 5E model had a positive impact on student activity, the level of knowledge acquisition, attitude towards subjects, and the formation of practical skills. The results were analyzed in the following four main areas:

1. Student activity and level of engagement in the lesson

Students actively participated in the lessons of the experimental group. Specifically:

- ✓ **89%** of students asked questions, commented, or participated in experiments during the lesson;
- ✓ Participation in group activities at each stage (especially "Search" and "Explanation") **strengthened collaboration among students**;
- ✓ In the control group, this indicator was around **57%**, and student activity was lower.

2. Indicators of knowledge acquisition

The test results at the end of the experiment showed:

- ✓ **The average learning rate** of students in the experimental group was **83%**;
- ✓ In the control group, this indicator was **64%**;
- ✓ In particular, the experimental group showed a significant advantage in such skills as **application of concepts, analysis of the problem, analysis of the experimental result.**

3. Interest and motivation in subjects

According to the results of the surveys:

- ✓ **93%** of students in the experimental group rated science lessons as "interesting" or "very interesting";
- ✓ Parents reported a **76%** increase in their children's interest in subjects;



✓ According to teachers, after lessons based on the 5E model, students attempted to **ask more questions, express opinions, and solve problem tasks.**

4. Formation of competencies

Through experimental lessons, the following important competencies were developed in students:

- ✓ **Research skills** (observation, experimentation, recording results);
- ✓ **Critical thinking** (analyze, differentiate, show cause-and-effect relationships);
- ✓ **Creative thinking** (proposing your own approach to new problems);
- ✓ **Collaboration** (group work, listening to and respecting others' opinions).

It was also observed that students developed a culture of expression of opinions, the ability to substantiate their opinion with evidence.

The results of the conducted research have proven that teaching natural sciences in primary education based on the 5E model ensures the active involvement of students in the learning process. Compared to traditional approaches, in lessons based on the 5E model, students not only acquire knowledge, but also acquire it through independent research, experience, and analysis. This ensures their ability to understand more deeply and apply it in practice.

These results are related **to the theory of constructive learning. Piaget and Vygotsky**, substantiating educational constructivism, emphasized that knowledge should be formed not in a ready-made form for the student, but in the process of active research and communication. The 5E model creates precisely such an active learning environment: the student asks questions, observes, analyzes, conducts experiments, and draws conclusions. This **contributes to the formation of not only knowledge**, but also **such competencies as** research, critical thinking, creativity, and collaboration.

In the lessons, the "Attraction" stage played an important role in concentrating students' attention and their psychological preparation for the lesson. The "research" stage directed students towards independent thinking and experimentation, encouraging them to take active action on the topic being studied. At the "Explanation" and "Expansion" stages, students learned to generalize



knowledge and apply it in a new context. At the final "Assessment" stage, they had the opportunity to analyze their activities and exchange opinions.

Questionnaires and interviews revealed that in lessons based on the 5E model, students strive for greater participation, are not afraid to answer questions, and are inclined to collaborate. This allows the teacher to conduct lessons in a **more student-centered** format. Parents also noted positive changes in their children's attitudes towards lessons, their ability to observe and reflect in everyday life.

Also, lessons organized through the 5E model:

- Provides students **with a continuous interest in learning**;
- **Reduces monotony** in lessons and is enriched with action games and experiences;
- Expands the student's **awareness of interdisciplinary connections** (e.g., mathematical measurements, linguistic interpretation, drawing);
- Forms **stable motivation** in education.

These observations are also consistent with other scientific studies. In particular, R. Bybee (2006) says the following about the role of the 5E model in shaping the student as an active participant: "The 5E model activates the student's thinking activity, deepens the assimilation of concepts, and enriches the learning process with personal experience."

Accordingly, it can be assumed that the 5E model can be successfully applied not only in the natural sciences, but also in other disciplines. However, the qualifications of teachers, methodological training, and the necessary resources for the lesson (experimental equipment, visual aids, time allocation) are important factors in the implementation of this model.

RESULT

The above analysis shows that teaching natural sciences in primary education based on the 5E model not only increases the level of students' knowledge, but also develops their skills in forming scientific thinking, independent thinking, research, and collaborative work. Compared to traditional lessons, lessons structured on the 5E model make the student an active participant in the lesson, not a passive listener. The greatest advantage of the 5E model is the organization of the educational process in accordance with the development of the student's thinking, dividing it into natural logical stages. At each stage, the student forms, assimilates, and



reinforces their knowledge through research and experience. In particular, the stages of "Search" and "Assessment" strengthen students' active thinking, as a result of which the lesson proceeds in an atmosphere of activity, research, and communication.

The research results confirmed the effective application of the 5E model in primary education. Students' interest in the lesson increased, their knowledge gained in class was connected with real life experience, and also had an organic impact on extracurricular activities. This situation shows that the role of the 5E model in the comprehensive development of the student's personality is high.

At the end of the article, the following conclusions were made:

- The 5E model provides easy, step-by-step learning for primary school students;
- Students acquire knowledge not in a ready-made form, but through research, experience, and discussion;
- Lessons based on the model develop students' activity, independence, and communication culture;
- Methodological training of teachers according to the 5E model is an important factor in the quality of education;
- This model fully corresponds to the requirements of modern education based on a competency-based approach.

Based on this, the following is recommended:

1. Organization of methodological manuals and advanced training courses for primary school teachers according to the 5E model;
2. Inclusion of tasks, experiments, and problem situations based on the 5E model in natural science textbooks;
3. Strengthening attention to providing schools with science laboratories, experimental equipment, and visual aids;
4. Testing and analysis of the 5E model in other disciplines.

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