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Article

Organizing Science Lessons Based on the Inquiry-Based 5E Model

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Abstract: This article explores the implementation of the 5E inquiry-based teaching model to enhance science lessons, focusing on engaging students actively in learning through exploration, experimentation, and reflection. The study uses a structured approach based on cognitive psychology and constructivist learning theory to guide teachers in applying the 5E model's phases: Engage, Explore, Explain, Elaborate, and Evaluate. Teachers participated in professional development courses to strengthen their lesson-planning skills for inquiry-based education. The results show that the 5E model effectively improves students' scientific understanding and promotes higher engagement by aligning lessons with students' interests and prior knowledge. Findings support the integration of inquiry-based learning as a core method in science education reforms, advocating for further training to improve instructional quality. This research underscores the potential of the 5E model to modernize science education, making it more interactive and student-centered.

Keywords: Inquiry-based learning, 5E Model, Science Education

1. Introduction

In educational institutions of our republic, systematic reforms have been carried out in the teaching of mathematics and natural sciences, enhancing scientific literacy among students, preparing them for real-life situations, participating in international assessments of education quality, strengthening cooperation with foreign countries in the field of education, studying advanced practices and modern teaching methodologies, and applying innovative approaches in the professional development of pedagogical staff. Along with the completed work, there is an increasing need to ensure integration in the teaching of sciences, including the creation of high-quality methodological and didactic materials for teaching natural sciences (Science), developing teachers' research skills, and advancing teaching methods. One of the main priorities of the national program for the development of school education in our country is to "fully implement the National Curriculum developed based on advanced international practices in school education" [1].

This reform emphasizes the need to encourage students' active participation in the teaching process, create opportunities for collaborative learning, and reduce reliance on rote memorization in education. Additionally, the application of inquiry-based learning methods is a key component of these reforms. This article discusses an inquiry-based learning cycle that promotes research-oriented education.

Literature Review. Inquiry-based learning allows students to independently discover knowledge. This method differs from traditional teaching approaches, as the

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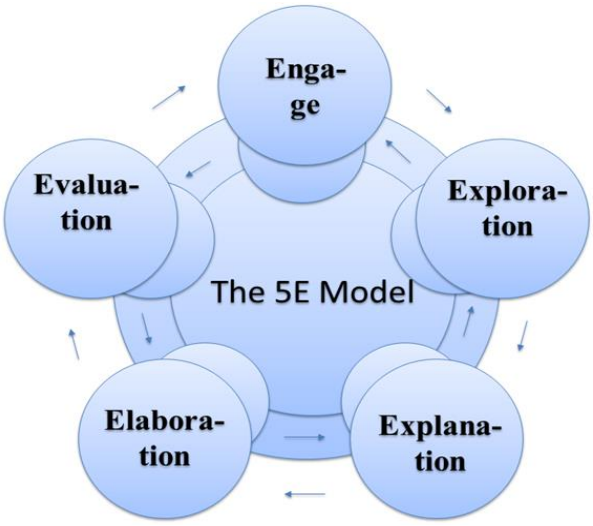
teacher merely provides guidance and enables students to explore and learn on their own [2,9,10]. At the beginning of the 20th century, this approach started to be increasingly implemented in scientific education, and later in the 1950s and 60s, it became more widely adopted. Today, international education standards consider the research method as a core element of science education, placing it at the center of the teaching process.

Inquiry-based learning is a multifaceted activity that involves conducting observations, posing questions, verifying existing information from books and other sources, planning research, revisiting prior knowledge based on experimental results, using tools to collect, analyze, and interpret data, proposing answers, explanations, and predictions, and presenting findings. While inquiry-based reforms are widespread across the country, many teachers face challenges in understanding how to design science lessons that support inquiry-based research learning in their classrooms. However, implementing and applying inquiry-driven methodologies in the classroom can be achieved through utilizing project-based lesson plans focused on inquiry-based research [3]. An example of such a project is the 5E model. This teaching method, based on a structured planning approach in multiple stages, aligns with constructivist ideas about how individuals learn and Piaget's theory of cognitive development [4,8,11]. The strong rationale for implementing inquiry-based science lessons using the 5E model as a strategy for inquiry-based research is demonstrated by Abraham [3].

2. Materials and Methods

The 5E teaching model can be applied in the development of each of its stages, and it is based on cognitive psychology, constructivist learning theory, and best practices in science teaching [1]. The model, shown in Figure 1, includes the cognitive stages of learning: engagement, exploration, explanation, elaboration, and evaluation.



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Bybee emphasizes: "When using this approach, students reorganize, correct, expand, and modify their existing knowledge. Reflective self-assessment, as well as interaction with peers and the environment, leads to the development of new concepts. Students interpret events and relate them to their existing concepts" [5; p. 76]. Science teachers can adapt and apply this model at various levels. We will describe each phase of the 5E learning model.

Engage: In this phase, the teacher identifies the students' prior knowledge and identifies any gaps in their understanding of the topic. This phase is student-centered, where the teacher aims to engage students and spark their interest through problem-based questions. It is recommended that the teacher uses interesting events, experiments, problem situations, and videos related to the topic. During the engage phase, the teacher

should not deliver scientific-theoretical knowledge through lectures, nor should they recite definitions, laws, or provide explanations and interpretations.

Exploration: The next phase is the exploration phase, where students are given tasks aimed at conducting experiments and research on the topic being studied. This phase is student-centered and involves an active learning process. Students are directed to develop life skills through observations, conducting experiments, performing research, comparing, classifying, creating hypotheses and testing them, and drawing conclusions. The key feature of this phase is that before explaining scientific knowledge, practical experience related to that scientific knowledge is provided to the students.

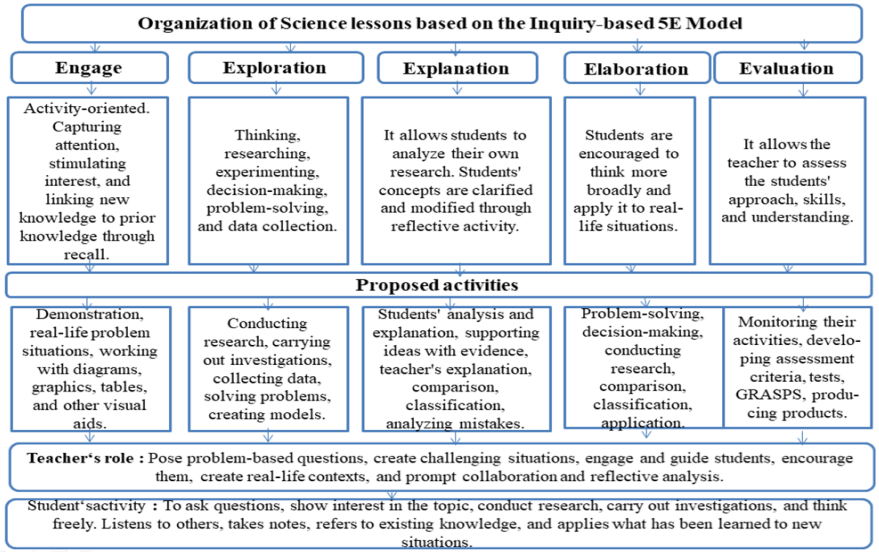
Explanation: In the explanation phase, the teacher first identifies the existing concepts and gaps in students' understanding from the first two phases and helps to fill these gaps. This phase provides students with the opportunity to present their own concepts and ask new questions related to the topic studied. Before providing an explanation, the teacher allows students to express their thoughts and share their ideas. After students present their explanations, the teacher clearly provides scientific and technical information. The teacher may also use visual aids, such as videos or computer programs, to help improve students' understanding.

Elaboration: In this phase, students are directed to connect the new knowledge they have gained to their existing knowledge and apply it in new situations. Students are encouraged to conduct experiments based on project work, new experiences, or models, and to deepen and broaden their understanding of concepts through case studies. Students may carry out additional research, create new products, share information and ideas, or apply their knowledge to other subjects. This phase also offers opportunities for the integration of different disciplines.

Evaluation: In inquiry-based teaching, assessment differs from traditional teaching assessments. Both formal and informal assessment methods should be applied together. In lessons based on the 5E model, evaluating students covers the entire teaching process. The teacher continuously observes the students and corrects any misconceptions that arise. Additionally, students may assess themselves or their peers [15].

3. Results and Discussion

Organizing science lessons (Science) based on the 5E model has proven to be effective. First and foremost, it is necessary to develop teachers' skills in organizing such lessons correctly. For this purpose, short-term courses for science teachers were organized, and the course program included the topic "Methodology for Organizing Lessons Based on the 5E Model". The following table illustrates how a structure for organizing lessons effectively using the 5E model was developed (Figure 2).



The structure for organizing lessons based on the 5E model allowed teachers to tailor lessons to the individual needs of students [11,12,13,14]. Teachers often follow the sequence of sections or topics as given in the textbook. However, diverse and flexible teaching methods help support children who struggle with attention. The 5E model serves as a tool for teachers to make new or less engaging topics interesting for students.

After participating in the programs, teachers gained new skills and demonstrated increased confidence in teaching natural sciences (Science) based on inquiry.

4. Conclusion

New national perspectives on education and teaching are being promoted in our country. This requires updating the educational process and teaching methodologies. Many of the adopted documents indicate the necessity of transforming the educational process into an active, inquiry-based environment across our country. Teachers are choosing this non-traditional teaching approach. This model helps teachers organize effective, inquiry-driven lessons. In doing so, it showcases the best teaching practices integrated with the theory of constructive education

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