
**PREPARING STUDENTS FOR TEACHING SCIENCE SUBJECTS BASED ON
ADEQUATE MODELS**

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Abstract

This article serves as a methodological guideline aimed at further improving the methodological training of students in natural sciences based on adequate models. The organization of the educational process in natural sciences involves collaboration between schools and preschool education institutions. This cooperation significantly contributes to the formation of students as competent professionals in their respective fields. The role of adequate models is indispensable for the thorough study of living organisms encountered in nature within the educational process. Therefore, lessons become clear, engaging, and yield effective results for students. Adequate models, which specifically facilitate the organization of natural phenomena in the classroom, presenting exact models of the organisms to be studied, and recreating a natural environment during the lesson, serve as an attention-grabbing and stimulating teaching tool.

Keywords: STEAM, constructivist learning model, simulation, virtual lesson, video analysis, reflective journal, competency, conceptual approach, adequate model, creative approach.

INTRODUCTION

In recent years, the integration of natural sciences in the general secondary education system has become one of the key directions. This development requires a new approach to the methodological training of future teachers. In particular, the use of adequate models (i.e., those that are content-appropriate and practically relevant) in the educational process expands opportunities to develop interdisciplinary knowledge and skills among students. A modern teacher must engage in effective communication with students, employ advanced teaching methods, and accurately model and explain the educational content.

Especially in the process of preparing students for the teaching profession, a high level of methodological training is essential. This article analyzes the theoretical and methodological foundations, didactic concepts, and international experience regarding the issue of methodological training of students based on adequate models. The significance of this research lies in the fact that an adequate pedagogical model enables teachers to operate based on real pedagogical situations and fosters their ability to independently make decisions in problematic contexts.

The article examines conceptual approaches to pedagogical modeling and presents recommendations based on international experience. The aim of the study is to identify ways to improve students' methodological training based on adequate models, analyze existing approaches, and develop recommendations grounded in global best practices. The research also substantiates the effectiveness of adequate models (activity-based approach, STEAM, constructivist learning model) in the methodological preparation of students for teaching natural sciences.

LITERATURE REVIEW

In Y.V. Malikova's 3rd-grade natural sciences textbook, we observe a practical implementation of integrated teaching methods. The topics presented in the textbook encourage a creative and experience-based approach to learning. Naturally, this enhances the significance of adequate models. Subjects such as animals, plants, the Earth, climate and weather, the Earth's surface, matter, energy, sound, the human body, and hygiene are illustrated with corresponding examples, substitutes, and models that are very clear and comprehensible. For instance, the clear explanation of good and harmful types of invisible bacteria serves as convenient knowledge for memorization. The engaging tasks, problem-based situations, and creative questions stimulate critical thinking and foster an active learning environment [1, pp. 3–132].

Wiggins and McTighe, in their work *Understanding by Design*, describe a competency-based approach where students engage in project design and modeling. This research focuses on educational and design fields, summarizing the works of many scholars. The creative approach emphasizes achieving excellent results, improving teachers' explanatory methods, and searching for the best ways to facilitate student understanding by using complex observation techniques. This process involves the mental construction of knowledge parts by human cognition. Moreover, students are encouraged to apply learned concepts practically, creatively use their knowledge in new situations, and develop flexibility and problem-solving skills [2, pp. 140–155].

Markova B.A. and Averin S.A.'s educational module, "**Didactic System of Friedrich Froebel**," extensively discusses the results of applying STEM technologies within the modeling system. This book clearly presents the teaching system based on STEAM models, which is considered one of the most relevant educational approaches today. Friedrich Froebel elaborated on the creation of many living and non-living objects encountered in real life through the design of various geometric shapes. This approach has a high level of clarity and comprehension.

The book recognizes Froebel's use of colored spheres, geometric shapes, and different forms as an adequate model that reflects living and non-living nature in a playful and creative way. For example, simple squares and rectangles are used to create models of animals, various architectural structures, household appliances, and many types of toys. Markova and Averin's work is based on Froebel's pedagogical belief that human abilities develop through activity and simultaneously evolve during this process. Accordingly, the pedagogical process involves "movement, labor, and thought," and the entire

educational system, including pedagogical education, functions under the guidance of the teacher.

Froebel's theories have retained their relevance despite many years of practical application, which is why scholars continue to study his didactic model in depth [3, pp. 4–48].

ANALYSIS AND RESULTS

An **adequate model** is a didactic structure that corresponds to educational reality and is based on the interaction between the teacher and the student. Such a model relies on competency-based, constructivist, and reflective approaches.

• The following stages were identified in the methodological training of students:

1. Providing theoretical knowledge (pedagogical models, methods, technologies).
2. Lesson planning based on practical exercises.
3. Self-analysis and reflection on solving problematic situations.

International experience shows that in the education systems of Finland, Estonia, Korea, and Singapore, teacher training based on modeling emphasizes the following:

- Simulation (virtual lessons, interactive environments).
- Decision-making based on problematic situations.
- Implementation of digital technologies in education.

Although more traditional approaches are still prevalent in Uzbekistan, a gradual transition to a competency-based model is underway, guided by the **Law on Education** and the **Concept for Education Development until 2027**. This indicates that the adequate model serves to achieve higher educational outcomes today. The research results indicate that the use of an adequate model in methodological training creates significant opportunities for preparing students for real pedagogical activities. Specifically, through lesson planning, analysis, and modeling problematic situations, students begin to envision themselves as real teachers. Studying practical teaching experiences and developing relevant skills are crucial for forming competent, modern, and capable individuals in the future.

In the constructivist approach, students acquire knowledge not in a ready-made form but through inquiry, experimentation, and reflection. This harmonizes skills, activities, and reflection within methodological training. Therefore, in preparing students for pedagogical education, it is necessary to use active methods such as simulation-based virtual lessons, video analysis, and maintaining reflective journals.

CONCLUSION

The results of the study demonstrate that in the methodological training of future teachers, it is essential to work with models that closely resemble real educational environments and are practical in nature. This approach not only develops theoretical knowledge but also fosters competencies in lesson planning, the use of interactive methods, and the explanation of interdisciplinary connections. Methodological training of students based on adequate models is a crucial stage in their professional

development. Through this, teachers acquire skills to apply modern educational technologies, plan lessons effectively, establish productive communication with students, and solve practical problems. The study analyzed the main directions of pedagogical modeling, didactic concepts, and international experience, and proposed ways to adapt these approaches to the national education system.

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