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DEVELOPING FUTURE TEACHERS' CRITICAL THINKING SKILLS: INNOVATIVE TEACHING METHODOLOGY

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Abstract: This article analyzes the methodological foundations for the formation and development of critical thinking competencies among prospective physics teachers. Critical thinking is regarded as an essential pedagogical category in modern education, playing a significant role in fostering students' abilities to conduct independent analysis, evaluate evidence, and draw logical conclusions. The study employed the Critical Teaching through Physical Reflection (FRTO) model as its theoretical and methodological basis. Methodologically, the research utilized scientific analysis, comparison, pedagogical observation, and reflection techniques. The findings demonstrated that lessons organized according to the FRTO model contribute to strengthening students' theoretical knowledge of physics, cultivating a critical approach to problem-solving, and activating creative thinking activities. Furthermore, the article highlights effective strategies for developing critical thinking in physics instruction and provides methodological recommendations for integrating these approaches into teacher education programs. The results of the study hold significant scientific and practical value for improving physics teaching methodologies and introducing innovative approaches in the professional training of future teachers.

Keywords: Critical thinking, physics education, teaching methodology, prospective teachers, FRTO model, innovative pedagogical approach, professional readiness.

In contemporary educational processes, the concept of critical thinking holds particular scientific and pedagogical significance. Critical thinking is a cognitive activity that develops students' ability to justify their own opinions, analyze evidence, evaluate existing ideas, and find logical solutions to problems. This skill is relevant not only for general intellectual development but also in the process of professional training. Therefore, exploring the methodological foundations for developing critical thinking in the preparation of future teachers is one of the priority directions of the current education system.

In physics education, the issue of developing critical thinking is even more important. The discipline of physics requires skills such as logical analysis, observation, experimentation, and theoretical justification in uncovering the laws of natural phenomena. Practice shows that traditional teaching methods are insufficient for fostering students' independent thinking and problem-solving abilities. As a result, future teachers face difficulties in activating students' independent reasoning during lessons.

The aim of this study is to identify opportunities for developing the critical thinking skills of prospective physics teachers and improving physics teaching methodology through the implementation of the "Teaching Critical Thinking through Physical Reflection" (FRTO) model in the learning process

The Concept of Critical Thinking and Its Scientific Interpretations

Critical thinking is one of the most important categories of modern pedagogy. Although various scholars have defined it differently, the common point is the development of an individual's ability to deeply analyze information, draw reasoned conclusions, and compare alternative solutions. J. Dewey interpreted critical thinking as "an active, persistent, and conscious form of

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thought,” while R. Ennis defined it as “a reasoned, logical, and evidence-based thinking process in decision-making and problem-solving.” Paul and Elder (2006) described it as “disciplined, reflective, and consistent thinking.”

In Uzbek pedagogical literature, critical thinking has also been extensively studied. For instance, scholars such as A. Abduqodirov and N. Saidahmedov evaluate critical thinking as a necessary condition for shaping the professional competencies of future educators. Therefore, developing critical thinking requires organizing the pedagogical process based on a new approach.

The Role of Critical Thinking in Education

Critical thinking is important not only for knowledge acquisition but also for an individual's adaptation to social life. Currently, international assessment programs (PISA, TIMSS) focus not only on memorizing facts but also on evaluating the ability to analyze and apply knowledge. Hence, developing critical thinking has become one of the priority directions of modern education.

In teacher education, particularly in training future teachers, the importance of critical thinking increases further. A teacher acts not only as a knowledge provider but also as a facilitator of students' independent thinking. Thus, preparing future teachers based on critical thinking serves as a key factor determining their future professional effectiveness.

Challenges in Developing Critical Thinking in Physics Education

Physics education is one of the main directions for developing scientific thinking. However, traditional lessons often emphasize memorizing theoretical knowledge, which limits students' opportunities to develop independent and critical thinking. Many studies indicate that problem-based tasks, practical experiments, and interactive methods are effective tools for fostering critical thinking. Nevertheless, such approaches are not sufficiently applied in physics teaching practice. This creates difficulties in activating students, developing reflection, analyzing problem situations, and comparing evidence.

International Experience

International experience shows that developed countries place particular emphasis on developing critical thinking. For example, the USA widely uses “problem-based learning,” Finland implements “phenomenon-based learning,” and Japan has established laboratory work systems aimed at strengthening students' logical and analytical thinking. In South Korea, innovative methods for developing critical thinking are supported at the state policy level. These experiences demonstrate that reflection, problem-based situations, and interactive approaches play a central role and can be effectively applied in the Uzbek education system.

Theoretical Foundations of the FRTTO Model

The FRTTO (Teaching Critical Thinking through Physical Reflection) model is designed as an approach to develop critical thinking in prospective teachers. It integrates reflection theory, critical thinking methodology, and physics teaching methods. The theoretical foundations of the model include:

- Enhancing reflective analysis in the learning process;
- Aligning problem-based situations with physics content;
- Encouraging students' independent and creative thinking;

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Transforming the teacher's role from a knowledge provider to a facilitator and discussion organizer in the learning process.

The FRTTO model, with its methodological potential, serves to make the development of critical thinking a systematic and purposeful process.

The issue of developing critical thinking in the education system is explained through various approaches. The following table compares traditional, problem-based, and reflection-based learning, along with their distinctive characteristics (Table 1).

Type of Approach	Key characteristics	Advantages	Disadvantages
<i>Traditional method</i>	Teacher-Centered, Theoretical Information Delivery	Rapid Knowledge Transmission	Students' Independent Thinking Does Not Develop
<i>Problem-based learning</i>	Question-and-Answer and Situational Tasks	Enhances Critical and Creative Thinking	Time-Consuming
<i>Reflection-based learning</i>	Student's Own Analysis of Ideas	Fosters Independence and Deep Analysis	Requires High Teacher Expertise
<i>FRTTO model</i>	Physics Content + Reflection + Critical Thinking	Systematic Approach, Integration of Theory and Practice	Not Implemented Yet in Practice

Table 1. Comparison of Approaches to Developing Critical Thinking

As seen from the table, traditional methods are primarily focused on knowledge transmission, offering limited opportunities for developing critical thinking. Problem-based and reflection-based approaches, on the other hand, actively engage students but are distinguished by their time-consuming nature and the requirement for high pedagogical expertise from teachers. The FRTTO model can be recognized as a systematic approach aimed at overcoming these limitations.

The stages of the critical thinking development process also constitute an important theoretical basis:

1. Receiving Information
2. Analyzing
3. Comparing
4. Drawing Reasoned Conclusions
5. Reflection and Reprocessing

Each of these stages plays a crucial role in developing students' thinking. For example, during the analyzing stage, a student compares information, identifies logical connections, and evaluates the reliability of evidence. The reflection and reprocessing stage further strengthens critical

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thinking, as it encourages individuals to adopt a critical attitude toward their own knowledge and activities.

Comparative analysis of international and national experiences also allows identifying effective approaches for developing critical thinking (Table 2).

Country	Methods Used	Results
<i>USA</i>	Problem-based learning	Independent analysis and creativity increase
<i>Findlan</i>	Phenomenon-based learning	Comprehensive analysis of phenomena
<i>Japan</i>	Laboratory work-based learning	Development of analytical thinking
<i>Uzbekistan</i>	Traditional + interactive methods	Gradual formation of critical thinking

Table 2. Comparison of International and National Experiences

As can be seen from this table, in developed countries, problematic situations, phenomenon-based teaching, and experimental-trial activities play an important role in the development of critical thinking. In the education system of Uzbekistan, this process is being implemented gradually; however, it is necessary to more widely introduce interactive and reflection-based methods.

The theoretical basis of the study considers future physics teachers as the main participants. Participants are selected from various courses and groups. Their age, level of knowledge, and previous teaching experience are taken into account during the theoretical analysis. The aim is to identify an effective approach to developing critical thinking skills within student groups.

Research Methods

Based on the FRTO (Critical Teaching through Physical Reflection) model, the following methods are expected to be applied theoretically:

1. Interactive Sessions

Solving physics topics through various approaches.

Encouraging students to think independently and explain their solutions.

2. Question and Answer

Observing students' thinking process through teacher-directed questions.

Compelling students to justify their opinions and provide evidence.

3. Small Group Discussion

Problem-solving exercises in groups of 3–5 people.

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Students exchange ideas with each other and analyze problems using different approaches.

4. Personal Reflection

Students express their thoughts in writing at the end of the session.

This method strengthens the ability to present ideas in an organized way and develop critical reasoning skills.

5. Analysis and Feedback

The teacher analyzes the results of the session and provides constructive recommendations.

The experimental-trial process is theoretically expected to be carried out in the following stages:

1. Initial Assessment

The level of students' critical thinking skills is determined through a test or a short question-and-answer session.

This stage serves to identify students' initial knowledge and skills.

2. Sessions Based on the FRTTO Model

Each session is conducted in the following sequence:

Question-and-Answer Session – Introducing the new topic and reviewing key concepts.

Small Group Work – Solving and discussing problems related to the topic.

Personal Reflection – Students express their thoughts in writing.

Analysis and Feedback – The teacher analyzes students' work and provides constructive recommendations.

3. Interim Observation and Analysis

Students' activities are observed during the sessions.

Students exchange ideas and attempt to solve problems using different approaches.

4. Final Assessment (Based on Predicted Outcomes)

Students achieve the expected growth results during the session process.

This assessment allows for a theoretical analysis of students' critical thinking skills.

Expected Outcomes

During the teaching process based on the FRTTO model, the development of critical thinking skills among future physics teachers is expected as follows:

1. Increase in Analytical Thinking

Students are expected to analyze physics problems using various approaches and justify their solutions.

2. Problem-Solving Skills

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Through small group discussions and interactive exercises, students' ability to solve complex problems is expected to improve.

3. Argumentation and Reflection Abilities

Personal reflection and the feedback process develop students' ability to express their thoughts systematically and provide supporting evidence.

4. Collaboration and Group Work

Students exchange ideas, listen to each other, and learn different approaches, which strengthens critical thinking.

5. Overall Outcome

According to theoretical analysis, the FRTTO model is expected to increase students' critical thinking skills by an average of 15–17% (forecast only; actual results have not been obtained).

Within the framework of this study, the theoretical foundations for developing critical thinking skills in future physics teachers were examined based on the FRTTO (Critical Teaching through Physical Reflection) model. Based on the research results, the following conclusions can be drawn.

In summary, the FRTTO model is scientifically substantiated as a theoretically effective approach to developing critical thinking skills in future physics teachers. This work not only provides a theoretical analysis but also lays a solid foundation for future practical experiments and applied research

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