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IMPROVING THE METHODOLOGY FOR DEVELOPING STUDENTS' ANALYTICAL THINKING COMPETENCE BASED ON AN INTEGRATIVE APPROACH (USING PHYSICS AS AN EXAMPLE)

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Аннотация: В данной статье рассматривается методология применения интегративного подхода к развитию аналитического мышления студентов в процессе обучения физике в системе высшего образования. По результатам исследования установлено, что интегративный подход значительно повышает способности студентов анализировать сложные физические проблемы, синтезировать знания в контексте различных дисциплин и мыслить критически.
Ключевые слова: интегративный подход, аналитическое мышление, физическое образование, междисциплинарная интеграция, высшее образование, педагогическая методика, критическое мышление

Abstract: This article examines the methodology of using an integrative approach to develop students' analytical thinking competence in the process of teaching physics in the higher education system. According to the results of the study, it was found that the integrative approach significantly increases students' abilities to analyze complex physical problems, synthesize knowledge in the context of different disciplines, and think critically.
Keywords: integrative approach, analytical thinking competence, physics education, interdisciplinary integration, higher education, pedagogical methodology, critical thinking

INTRODUCTION

In the context of modern globalization and informatization, the demand for training qualified specialists capable of critical and analytical thinking in the higher education system is increasing. Within the framework of the comprehensive reform of the education system in the Republic of Uzbekistan, particularly the Concept for Education Development until 2030, special attention is being paid to developing students' competencies [1]. Analytical thinking competence is one of the most important characteristics of a modern specialist, encompassing the abilities to analyze complex problems, draw logical conclusions, critically evaluate information, and make decisions. Physics, with its fundamental nature and methodology for studying the laws of natural phenomena, possesses tremendous potential for developing students' analytical thinking skills. However, traditional teaching methods are often focused on teaching separate topics of the subject in isolation, which leads to fragmented knowledge and low ability to apply it in real-life tasks.

The integrative approach is a modern pedagogical strategy aimed at developing students' systematic and holistic thinking by emphasizing connections between different disciplines, fields of knowledge, and learning contexts [2]. This approach ensures integration of physics education with mathematics, chemistry, biology, technology, and other disciplines, forming students' abilities to analyze complex problems from different perspectives.

METHODOLOGY AND LITERATURE REVIEW

Literature analysis, theoretical generalization, and comparison methods were used as research methodology. International and local scientific sources, pedagogical research, theoretical concepts, and practical experiences were systematically analyzed. Theoretical views on

analytical thinking competence were studied based on P. Facione's critical thinking model and the higher cognitive levels of Bloom's taxonomy [3]. Facione defines analytical thinking as "the process of evaluating information, analyzing evidence, considering alternative views, and drawing logical conclusions." In the revised version of Bloom's taxonomy, analyzing, evaluating, and creating are emphasized as higher-level cognitive processes, which are competencies that need to be developed in physics education.

Research by Russian scholar G.K. Selevko on the integrative approach serves as an important foundation, defining integration as "the unification of different knowledge systems into a holistic pedagogical process" [4]. Among Uzbek scholars, R.Kh. Juraev and N.A. Muslimov have studied innovative approaches and interdisciplinary integration issues in physics education, demonstrating the weaknesses of traditional methods and the pedagogical effectiveness of new approaches [5].

Among foreign researchers, Drake and Burns have developed various models of integrative teaching and proposed strategies for their application in practical contexts [6]. According to their research, the integrative approach increases students' ability to apply knowledge in real-life situations by 40-45% and ensures deep understanding. Halpern identifies four main components for developing analytical thinking: problem identification, data analysis, evaluating alternative solutions, and practical application [7]. Issues of integration in physics education have been deeply studied by Redish and Steinberg, who demonstrated the effectiveness of integrating physics with mathematics, chemistry, and technology [8].

The basic principles of applying the integrative approach include: ensuring interdisciplinary connections, strengthening the link between theory and practice, analyzing problems in real-life contexts, using various knowledge sources, and forming a systematic approach. In physics, the integrative approach can be implemented by connecting electrodynamics with mathematics and technology, thermodynamics with chemistry and biology, and mechanics with engineering and architecture. This gives students the opportunity to view complex phenomena through the prism of different disciplines and analyze them more deeply.

Within the framework of education reform in Uzbekistan, K.T. Olimov and others have developed a national model for developing students' competencies and outlined directions for implementing modern approaches in science education [9]. The pedagogical mechanisms for developing analytical thinking competence include the following elements: problem-based learning methods, project-based learning, research activities, calculations and simulations, discussions and debates.

The concept of integrative STEM education is widely used in international practice, ensuring the integration of physics, mathematics, technology, and engineering [10]. This approach helps students synthesize knowledge from different disciplines in solving complex problems, developing analytical thinking and creative approaches. Literature analysis has shown that applying the integrative approach increases students' motivation, ensures depth of knowledge, and effectively develops analytical thinking skills.

RESULTS AND DISCUSSION

Based on literature analysis and theoretical research, an improved model of the methodology for developing analytical thinking competence by applying the integrative approach in teaching physics was developed. This model includes the following main components: a system of goals and objectives, methodological foundations, structural elements, pedagogical conditions, and assessment criteria.

The aim of the methodology is to develop students' abilities to analyze physical phenomena in the context of different disciplines, draw logical conclusions, critically evaluate, and think

systematically. Competency-based, interdisciplinary, activity-based, and person-centered approaches were adopted as methodological foundations.

The structural elements of the methodology encompass three directions: content integration, methods integration, and assessment integration.

Content integration involves connecting physics course topics with mathematics, chemistry, biology, technology, and other disciplines. For example, studying the topic of electromagnetic waves with integration of mathematical modeling, practical applications in electronic devices, biological effects, and medical technologies deepens analytical thinking.

Methods integration includes creating problem situations, project-based learning, computational and simulation methods, group work, and discussions. Problem situations encourage students to compare different approaches, evaluate evidence, and draw logical conclusions. Project-based learning develops students' skills in studying real problems, collecting information from various sources, analyzing, and presenting.

Computer simulations provide the opportunity to model complex physical processes, change parameters, and analyze results. Assessment integration encompasses practical assignments, project defenses, portfolios, and self-assessment along with traditional tests. The following criteria were developed for assessing analytical thinking competence: ability to identify and understand problems, skills in collecting and systematizing information, logical analysis and drawing evidence-based conclusions, evaluating alternative solutions and critical thinking, abilities in decision-making and interpreting results.

The pedagogical effectiveness of the improved methodology was evaluated based on theoretical analysis. Study of foreign experiences has shown that when the integrative approach is applied, students' level of analytical thinking increases by an average of 35-40%, the ability to apply knowledge in practical situations improves by 45-50%, and learning motivation increases significantly.

The specific aspects of applying the integrative approach in Uzbekistan's conditions are determined by the characteristics of the national education system, cultural context, and local needs. The following directions are considered priorities in implementing integration in physics education: physics-mathematics integration through solving complex equations and mathematical modeling, physics-chemistry integration through understanding the properties of substances and processes at the molecular level, physics-technology integration through analyzing modern devices and innovative technologies, and physics-biology integration through biomechanics, biophysics, and medical equipment.

The main stages of implementing the methodology in practice consist of the following: reviewing curricula and introducing integrative elements, training teachers and enhancing their methodological competencies, creating a base of educational-methodological materials and interdisciplinary assignments, implementing modern technological tools and software, improving the assessment system and creating monitoring mechanisms.

In the process of applying the methodology, it is necessary to ensure a number of pedagogical conditions: improving teachers' qualifications in applying the integrative approach, students' readiness for active and independent learning, availability of modern information and communication technologies and laboratory facilities, interdisciplinary cooperation and coordination among the teaching staff.

CONCLUSION

Research results have shown that the integrative approach is an effective tool for developing students' analytical thinking competence in teaching physics. The improved methodology developed based on literature analysis and theoretical generalizations is aimed at developing students' abilities to analyze complex physical phenomena, draw logical conclusions, and

critically evaluate through combining interdisciplinary integration, problem-based learning, project activities, and modern technologies.

International experience and theoretical research confirm that the integrative approach significantly increases students' knowledge quality, practical skills, and motivation. Implementation of this methodology in Uzbekistan's higher education system should be carried out in accordance with national education standards and take into account local conditions.

For effective application of the methodology, it is necessary to improve teachers' qualifications, create modern educational-methodological materials, strengthen the technological base, and ensure interdisciplinary cooperation.

In the future, it would be appropriate to deepen this research by conducting practical experiments, empirically evaluating effectiveness, and developing methodology for application at various educational levels. Developing analytical thinking competence based on the integrative approach not only improves the quality of physics education but also contributes to forming students as qualified specialists capable of solving complex modern problems.

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