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DESIGNING PHYSICS LESSONS BASED ON COGNITIVE AND METACOGNITIVE STRATEGIES

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Abstract: This article explores the theoretical and practical aspects of designing physics lessons based on cognitive and metacognitive strategies. Cognitive approaches aim to develop students' skills in understanding, processing, and applying knowledge, while metacognitive strategies foster their ability to plan, monitor, and evaluate their own learning activities. The article analyzes a step-by-step methodology for organizing the lesson process, using examples such as reflection, problem-based instruction, K-W-L charts, and self-assessment tools. The findings indicate that these strategies play a significant role in shaping students' abilities for deep thinking, independent learning, and cultivating a culture of learning from mistakes.

Keywords: physics education, cognitive strategy, metacognitive approach, problem-based teaching, reflection, self-assessment, Bloom's taxonomy, independent learning, thinking competence.

Introduction: The modern education system is aimed at shaping students as active participants in the learning process. Particularly in the teaching of natural sciences—and physics in particular—it is essential not only to deliver knowledge but also to cultivate essential skills such as independent thinking, problem-solving, analytical reasoning, and self-assessment. To achieve these objectives, incorporating cognitive and metacognitive strategies into lesson planning significantly increases the effectiveness of instruction.

The cognitive approach helps students develop skills for acquiring, understanding, memorizing, and applying knowledge. Metacognitive strategies, on the other hand, enable learners to plan, monitor, and evaluate their learning process. When these two approaches are integrated, students not only gain a deeper understanding of physical concepts but also learn to apply them effectively in real-life situations.

In this article, the theoretical and methodological aspects of designing physics lessons based on cognitive and metacognitive strategies are analyzed, and the methods of applying these strategies in educational practice are explored.

Literature Review: In recent years, the importance of cognitive and metacognitive approaches in education has been steadily increasing. In international practice, these strategies are recognized as key tools for developing higher-order thinking skills in students. For example, R. Marzano, in his book "The Art and Science of Teaching", emphasizes that the primary task of a teacher is to activate students' thinking processes. Moreover, the problem-based teaching model developed by D. Jonassen also contributes to the development of both cognitive and metacognitive skills.

Uzbek scholars have also been conducting several scientific studies in this area. For instance, G. Abdurasulova's research on developing metacognitive skills in physics lessons and M. Hasanboyeva's studies on fostering thinking through interactive methods in physics education serve as important theoretical foundations.

The above literature review shows that the use of cognitive and metacognitive approaches in the classroom not only improves the level of knowledge acquisition but also enhances students' skills in independent learning, critical thinking, and reflection.

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Methodology: In designing physics lessons based on cognitive and metacognitive strategies, the methodological approach should aim to activate students' thinking processes and foster their self-regulation abilities at every stage. The teacher must place the student at the center of all instructional processes—from lesson planning to assessment—while considering their prior knowledge, cognitive abilities, and attitude toward self-directed learning. Therefore, the following section outlines the key methodological directions for organizing physics lessons through cognitive and metacognitive approaches.

Firstly, a strategic approach plays a crucial role in lesson planning. At this stage, the teacher structures the content of the lesson by addressing the following questions: "What does the student already know?" – assessing prior knowledge to evaluate readiness for new material; "What should the student learn?" – clearly defining the lesson objectives; "How will the student acquire knowledge?" – planning cognitive activities; and "How will the student monitor and control their learning?" – emphasizing metacognitive processes. Within this approach, formulating questions and tasks based on Bloom's taxonomy is highly effective, as it divides the learning process into sequential levels: knowledge, comprehension, application, analysis, synthesis, and evaluation.

Secondly, the teaching methods used during the lesson should be designed to activate both cognitive and metacognitive strategies. For example, the use of problem-based teaching increases students' ability to think independently, identify cause-and-effect relationships, and enhances their interest in problem-solving. Through methods such as clustering and brainstorming, students uncover connections between concepts and generate new ideas. The "I Know – I Want to Know – I Learned" (K-W-L) chart enables students to monitor their learning before, during, and after the lesson. Keeping a reflection journal allows students to analyze their participation, engagement, and knowledge acquisition in written form, thereby developing awareness and control over their thinking processes. Step-by-step guidance, in turn, supports students in planning, monitoring, and adjusting their learning strategies throughout the lesson.

Thirdly, the design of metacognitive tasks contributes to deepening students' self-awareness. For instance, reflective responses to questions such as "What did I learn? How did I learn it? What did it give me?" help students develop a culture of working on themselves. Furthermore, by analyzing their mistakes, students identify incorrect solutions, explain the reasons behind their errors, and attempt to correct them. Through this process, learners deepen their understanding of knowledge and enhance their analytical and problem-solving skills.

Fourthly, guiding students toward self-assessment during the evaluation phase is extremely important. This motivates learners to critically evaluate their knowledge, approach their academic activities with responsibility, and develop independent learning strategies. In this process, tools such as tests based on metacognitive questions, self-assessment scales, and the portfolio method (i.e., collecting and systematically analyzing all tasks completed throughout the course) are employed. This methodology helps to systematically demonstrate and monitor student progress.

In short, to teach physics based on cognitive and metacognitive approaches, the teacher must thoroughly plan the lesson, activate students' thinking at every stage through active teaching methods, and guide them toward independent learning. This, in turn, not only enhances the quality of education but also fosters the development of students as independent, inquisitive, and self-directed individuals.

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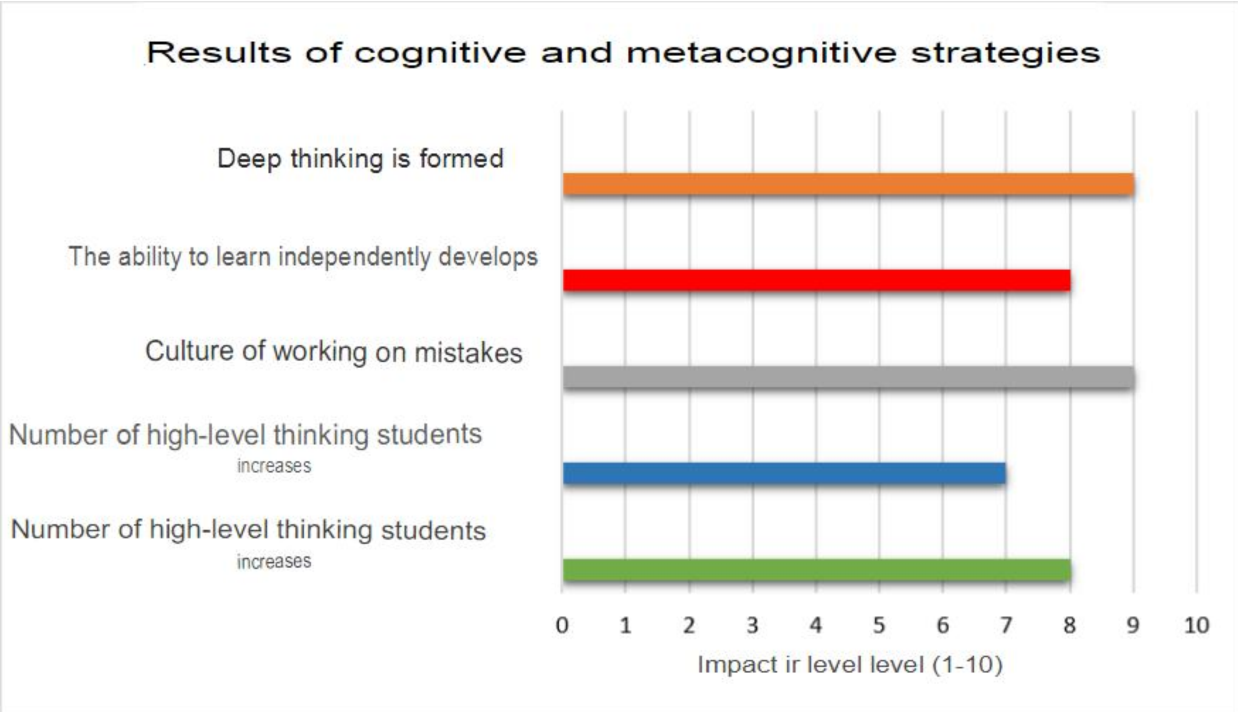
Theory and Results: The theoretical foundations underlying cognitive and metacognitive strategies are rooted in some of the most significant directions in educational psychology, including cognitive psychology, socioconstructivism, and metacognitive theories. These approaches are primarily based on the ideas of prominent scholars such as Lev Vygotsky, Jean Piaget, Jerome Bruner, and David Ausubel. According to their perspectives, learning is a process of constructing knowledge within the individual mind of the student, and this process is guided by the learner's ability to comprehend their own thinking, plan their learning, and monitor it effectively.

According to cognitive theory, the human brain contains a structured network of knowledge, and new information is assimilated by linking it to existing knowledge. Piaget referred to this process as "assimilation and accommodation." Vygotsky, on the other hand, introduced the concept of the



"zone of proximal development," in which learners can acquire knowledge they are not yet capable of learning independently, with the assistance of adults or more knowledgeable peers.

In the field of physics education, these theoretical perspectives are reflected as follows: the student becomes aware of their lack of knowledge, thus recognizing the need to learn; they decide how to acquire new information by forming appropriate learning strategies; they plan their learning process and monitor themselves throughout the activity; and, finally, they analyze their results at the end of the lesson and adjust their strategies if necessary.

№	Results	Impact level (1-10)
1	The level of mastery increases	9
2	Deep thinking is formed	8
3	Independent learning skills develop	9
4	A culture of working on mistakes	7
5	The number of high-level thinking students is increasing	8

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Such processes are examples of metacognitive activity and contribute to deep learning. In this way, the student learns to understand, regulate, and evaluate their own thinking process.

Practical Results: Practical outcomes demonstrate the effectiveness of these theoretical approaches. As a result of lessons structured around cognitive and metacognitive strategies: Students' comprehension levels increase; they understand lesson content more deeply and clearly; Students develop deep thinking skills and adopt an analytical approach to questioning; Their independent learning abilities are strengthened, making them more prepared to study new topics on their own; A culture of learning from mistakes is established—students learn to analyze incorrect responses and make better decisions; Consequently, the number of students with higher-order thinking skills increases, with noticeable improvement in cognitive depth and autonomy.

These outcomes help create an effective learning environment for both teachers and students, and they enhance motivation toward learning physics.

Conclusion: Teaching physics through modern approaches is one of the key priorities of today's educational system. In particular, integrating cognitive and metacognitive strategies into the learning process enables the development of high-level skills in students, such as independent learning, deep thinking, self-monitoring, and analytical reflection on their own activities.

Through cognitive approaches, students acquire knowledge in an accurate and structured manner, understand the relationships between concepts, and learn to apply their knowledge in practical contexts. Metacognitive strategies, in turn, allow learners to plan, manage, and evaluate their own learning processes. When applied in an integrated manner, these approaches significantly enhance students' engagement in lessons, comprehension levels, independent thinking, and creative approaches to learning.

Practical experience shows that physics lessons designed based on cognitive and metacognitive strategies not only enhance knowledge acquisition, but also contribute to the development of students as individuals capable of independent thinking, analytical reasoning, and self-regulation. Therefore, the broad integration of these strategies into teachers' everyday pedagogical practices can significantly improve the overall quality of education.

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