DEVELOPMENT OF CREATIVE ABILITIES OF STUDENTS IN PHYSICS SOLVING LESSONS (ON THE EXAMPLE OF ACADEMIC LYCEUMS)

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Annotation: In the education of the younger generation in this article, the methods of teaching taking into account the creative abilities of students in the lessons of solving problems in physics, taking into account the age aspects are considered on the example of academic lyceums.

Keywords: Creative thinking in physics education, problem-solving in physics, academic lyceum pedagogy, student-centered learning, inquiry-based methods, STEM education, age-appropriate teaching strategies, higher-order thinking skills, innovative learning environments, physics didactics.

Introduction

The modern educational landscape is shifting from a focus on rote learning to one that values the development of critical and creative thinking. In this context, physics plays a unique role. As a subject deeply rooted in understanding natural phenomena through principles and experimentation, it provides a powerful platform for cultivating students' intellectual and creative potential. Academic lyceums—educational institutions designed to provide advanced instruction for motivated and capable students—offer fertile ground for implementing innovative methods that support this goal.

At the heart of effective physics instruction is the task of problem-solving. However, when problem-solving is reduced to the mechanical application of formulas, its transformative potential is lost. The true educational power of physics emerges when students are encouraged to think independently, analyze from multiple perspectives, generate hypotheses, and develop unique solutions. To achieve this, educators must employ methods that align with both the developmental stage and the creative potential of lyceum students.

Main body

The development of **creative thinking in physics education** is not only a desirable educational aim but a necessary condition for preparing students for 21st-century challenges in science and technology. In the specialized context of **academic lyceums**, where students are selected for their advanced academic abilities and intellectual curiosity, the conditions are particularly favorable for the deliberate cultivation of creative potential. Physics, as a fundamental **STEM discipline**, inherently lends itself to this objective through its emphasis on problem formulation, abstraction, and modeling of the physical world.

Creativity in physics does not emerge from mechanical application of formulae but rather from students' ability to explore problems from **multiple perspectives**, synthesize cross-disciplinary knowledge, and generate original solutions. This process draws upon both **divergent thinking**, where a broad range of possibilities are generated, and **convergent thinking**, where the most effective solution is selected. According to Bloom's revised taxonomy, these are categorized under **higher-order thinking skills** such as analysis, evaluation, and creation—skills essential to **problem-solving in physics**.

Educational psychology offers rich insights into how creative abilities develop in adolescents. In particular, **constructivist learning theories** (Piaget, 1972; Vygotsky, 1978) stress the importance of learners actively constructing their own knowledge through meaningful engagement. Vygotsky's concept of the **Zone of Proximal Development (ZPD)** is especially pertinent in **student-centered learning environments**, where students are guided just beyond their current capabilities through carefully structured tasks and teacher facilitation. Within physics education, this means designing **age-appropriate teaching strategies** that encourage exploration, question formulation, hypothesis testing, and reflection.

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One effective approach is the use of **inquiry-based methods**, which position students as investigators of physical phenomena. Through experimentation, simulation, and guided research, students not only deepen their conceptual understanding but also enhance their ability to generate and test ideas creatively. For example, designing an energy-efficient building or simulating planetary motion requires not just factual recall but **innovative learning environments** that support risk-taking and experimentation.

Equally important is the role of **collaborative learning**. When students engage in group-based inquiry or jointly solve complex problems, they are exposed to diverse thought processes, argumentation techniques, and conceptual frameworks. This social interaction fosters **creative thinking in physics education** by developing **communication and metacognitive skills**, while also cultivating **flexibility**—one of the core traits of creativity. Such collaboration mirrors authentic scientific practice and prepares students for interdisciplinary teamwork in future scientific or engineering roles.

Context-rich problems and **model-based reasoning** are particularly powerful tools in developing creative ability. In these tasks, students must identify relevant variables, make reasonable assumptions, and apply **physics didactics** in novel ways. Digital tools such as simulations, data loggers, and computational modeling platforms further enhance these experiences, transforming the classroom into a **creative STEM lab** rather than a space for passive learning.

To genuinely nurture and evaluate creativity, assessment methods must align with these pedagogical changes. Traditional summative assessments do not capture the depth of a student's creative process. Instead, **alternative assessments**—including open-ended design tasks, project-based learning portfolios, and reflective journals—are better suited for measuring **student-centered learning** outcomes. These forms of evaluation emphasize process over product, allowing educators to assess **originality**, **fluency**, **flexibility**, and **elaboration**, all of which are established dimensions of creativity (Torrance, 1966).

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Recent empirical studies support the efficacy of these approaches. For instance, Freeman et al. (2014) demonstrated that **active learning** methods, especially those emphasizing peer interaction and exploratory learning, lead to significantly higher achievement and retention in **STEM education**. In academic lyceums where such strategies are systematically employed, students not only show superior performance on standardized tests but also display heightened motivation, stronger conceptual retention, and a more profound appreciation of physics as a discipline.

In conclusion, integrating **creative thinking** into **problem-solving in physics** through **student-centered**, **inquiry-based**, and **collaborative teaching strategies** significantly enriches the learning experience in **academic lyceums**. These practices align with the cognitive, emotional, and intellectual needs of adolescents, transforming physics education from a rigid system of facts into a dynamic, exploratory, and imaginative discipline that prepares students for innovation in science, technology, and beyond.

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