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DEVELOPING PROBLEM-SOLVING SKILLS THROUGH REAL-LIFE CONTEXTS IN CAMBRIDGE A-LEVEL PHYSICS

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Abstract

Problem-solving is a central skill in physics education, particularly within the Cambridge A-Level Physics curriculum, which emphasizes analytical thinking, application of knowledge, and interpretation of physical phenomena. However, many students struggle to transfer theoretical knowledge into unfamiliar or practical contexts. This paper explores the role of real-life, context-based problems in developing higher-order problem-solving skills among A-Level Physics students. Drawing on constructionist learning theory and inquiry-based pedagogical approaches, the study discusses how authentic scenarios enhance conceptual understanding, student motivation, and the ability to apply physics principles flexibly. Practical classroom strategies are presented, including contextualized numerical problems, experimental design tasks, and interdisciplinary applications. The paper also analyzes common student difficulties and offers instructional techniques that support structured reasoning, estimation skills, and reflective thinking. The findings suggest that integrating real-world contexts into physics instruction not only improves examination performance but also fosters scientific literacy and lifelong learning skills. These results have important implications for teachers implementing the Cambridge curriculum in diverse educational settings.

Keywords

problem-solving skills, A-Level Physics, Cambridge curriculum, real-life contexts, physics education, inquiry-based learning

Problem-solving is one of the most essential skills in physics education, especially within the Cambridge A-Level Physics curriculum, which emphasizes analytical reasoning, application of knowledge, and interpretation of physical phenomena. Despite learning formulas and theoretical concepts successfully, many students find it difficult to apply their knowledge to unfamiliar or real-world situations. This gap between theory and application highlights the importance of integrating real-life contexts into physics instruction to develop deeper and more flexible problem-solving skills.

Physics is not only a collection of laws and equations but also a way of understanding the world. However, traditional classroom practice often focuses on routine exercises where students follow memorized procedures to reach numerical answers. While this approach may help learners perform well in familiar exam questions, it does not adequately prepare them for complex, non-routine problems. Real-life contexts encourage students to think beyond formulas, analyze situations, make assumptions, and justify their reasoning, which are all key expectations in the Cambridge assessment framework.

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Learning theories support the use of contextualized problems. Constructivist theory suggests that students build knowledge actively by linking new information to their existing experiences. When physics concepts are connected to everyday life, students find them more meaningful and easier to understand. Inquiry-based learning also supports this approach, as real-life problems often require exploration, questioning, and step-by-step reasoning rather than simple substitution into equations. This helps students become independent thinkers rather than passive learners.

Real-life contexts are important because they bridge the gap between theory and application. Students often wonder about the purpose of learning abstract concepts, and contextual problems provide clear answers. For example, studying braking distances in cars allows learners to apply kinematics and energy conservation in a familiar situation. Similarly, analyzing electricity consumption at home can deepen understanding of power and energy topics. These connections make physics more relevant and easier to remember.

Another major benefit of real-world problems is increased motivation. When students see physics explaining sports performance, space exploration, renewable energy, or medical technologies, their curiosity grows. They begin to view physics not as a difficult subject full of equations, but as a powerful tool for understanding modern life. This positive attitude often leads to greater classroom participation and persistence when facing challenging tasks.

Working with real-life problems also develops transferable skills. Students learn to estimate quantities, interpret data, evaluate assumptions, and make decisions based on evidence. These skills are valuable not only for physics examinations but also for future academic studies and everyday life. For instance, estimation tasks such as calculating the energy needed to charge a phone or the power generated by a solar panel help students develop a sense of scale and numerical reasoning.

Different types of contextual problems can be used in A-Level Physics classrooms. One type involves numerical problems presented in realistic scenarios. Instead of asking students to calculate projectile motion in an abstract way, teachers might ask them to analyze the path of water from a fountain or the motion of a ball in sports. Students must identify relevant information, ignore unnecessary details, and model the situation using physics principles. This process strengthens their ability to translate words into equations.

Experimental design tasks are another powerful tool. Students can be asked to plan how to measure air resistance, determine the efficiency of an electric device, or investigate heat loss from materials. Such activities develop practical skills and align closely with Cambridge practical assessment criteria. They also encourage creativity and deeper understanding of experimental uncertainty and measurement limitations.

Estimation problems, sometimes called Fermi problems, are also valuable. These problems require students to make reasonable assumptions and perform approximate calculations. For example, estimating the number of air molecules in a classroom or the energy produced by a wind turbine encourages logical thinking and order-of-magnitude reasoning. Many students initially find estimation difficult, but regular practice builds confidence and scientific intuition.

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Interdisciplinary problems further enhance learning by showing how physics connects with other subjects. Analyzing the thermal insulation of buildings combines thermodynamics with environmental science. Studying medical imaging technologies links physics with biology and health sciences. These connections help students see physics as part of a broader system of knowledge rather than an isolated subject.

To implement real-life problem-solving effectively, teachers should begin lessons with engaging scenarios rather than formulas. A discussion about road safety can introduce momentum and impulse, while a situation involving satellite motion can lead into circular motion and gravitational fields. Starting with a context helps students understand why they are learning a concept before focusing on mathematical details.

Structured problem-solving frameworks also support students. Teachers can guide learners through steps such as understanding the problem, identifying known and unknown quantities, selecting relevant principles, carrying out calculations, and evaluating the final answer. Modeling this thinking process aloud helps students develop their own reasoning strategies. Over time, they become more confident in approaching unfamiliar problems independently.

Encouraging multiple solution methods is another effective strategy. Real-life problems often allow different approaches, and discussing alternative solutions promotes flexibility and deeper understanding. Reflection is equally important. After solving a problem, students should consider whether their answer is realistic, what assumptions were made, and how the result might change under different conditions.

Despite these benefits, students face common challenges. Many struggle to convert descriptive information into physics variables and equations. Drawing diagrams, underlining key data, and discussing the meaning of quantities can help overcome this difficulty. Others rely too heavily on memorized formulas instead of understanding underlying principles. Teachers should emphasize conceptual reasoning before calculations. Weak estimation skills also limit students' ability to judge whether answers are reasonable, so regular exposure to approximation tasks is important.

Training with real-life problems prepares students well for Cambridge A-Level examinations. Exam questions often present unfamiliar contexts, data analysis tasks, and experimental scenarios. Students who have practiced contextual problem-solving are better able to interpret graphs, explain reasoning clearly, and adapt their knowledge to new situations. They also tend to perform more confidently in extended-response questions that require explanation rather than simple calculation.

Beyond examination success, this approach promotes scientific literacy. Students learn to apply physics when thinking about energy use, climate change, transportation safety, and technological development. They become better equipped to evaluate information critically and make informed decisions in daily life. These outcomes reflect the broader educational goal of preparing responsible and knowledgeable global citizens.

The role of the teacher in this process is to act as a facilitator of thinking rather than simply a provider of answers. Asking guiding questions, encouraging discussion, allowing productive

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struggle, and giving feedback on reasoning help students develop independence. A classroom culture that values curiosity and persistence supports deeper learning.

In conclusion, integrating real-life contexts into Cambridge A-Level Physics is a powerful way to develop strong problem-solving skills. It strengthens conceptual understanding, increases motivation, and builds transferable analytical abilities. By moving beyond routine textbook exercises and using authentic scenarios, teachers can prepare students not only for academic success but also for real-world challenges. This approach reflects the core philosophy of the Cambridge curriculum, which values deep understanding and meaningful application of knowledge.

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