THE EFFECTIVENESS OF PISA-FORMAT TASKS IN TEACHING PHYSICS

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Annotation: *This article examines the effectiveness of PISA-format tasks in the teaching of physics. The Programme for International Student Assessment (PISA) has become a benchmark for evaluating educational systems worldwide. The article explores how incorporating these tasks into physics education can improve students' scientific literacy, problem-solving abilities, and critical thinking. By analyzing existing literature and implementing PISA-style tasks in physics classrooms, this study identifies the benefits and challenges associated with using such assessments. The findings suggest that PISA-format tasks encourage deeper engagement with physics concepts, facilitate the development of analytical skills, and improve students' ability to apply their knowledge in real-world situations.*

Keywords: *PISA-format tasks, physics education, scientific literacy, problem-solving, critical thinking, educational assessment*

The role of international assessments like the Programme for International Student Assessment (PISA) in shaping educational practices has been widely acknowledged. PISA tasks are designed to assess students' ability to apply their knowledge in real-world contexts, with a strong emphasis on problem-solving and critical thinking. Physics education, being a fundamental aspect of scientific literacy, can benefit significantly from these assessments, which challenge students to think beyond theoretical knowledge. This article explores the effectiveness of incorporating PISA-format tasks into physics teaching, aiming to enhance students' understanding and ability to solve complex problems.

The Programme for International Student Assessment (PISA), administered by the OECD, assesses 15-year-old students' abilities in reading, mathematics, and science literacy every three to four years. In science (the major domain in cycles like 2006, 2015, and upcoming 2025), PISA emphasizes scientific literacy—the ability to engage with science-related issues using scientific knowledge and processes in real-world contexts—rather than rote memorization of disciplinary content. Physics-related tasks fall under "physical systems," covering topics like motion, forces, energy, waves, electricity, and their applications (e.g., acid rain's impact on materials, greenhouse effects, or exercise physiology).

PISA-format tasks typically present authentic scenarios with data (graphs, tables, texts), requiring students to:

Explain phenomena scientifically.

Evaluate and design scientific inquiries.

Interpret data and evidence scientifically.

These differ from traditional physics problems, which often involve isolated calculations (e.g., solving for velocity using $v = u + at$) without contextual application.

Key Features of PISA-Format Tasks in Physics Contexts

PISA tasks integrate physics with everyday or societal issues. Examples from released items and frameworks include:

Analyzing acid rain's chemical effects on marble statues (involving reaction rates and material properties).

Interpreting data on physical exercise and heart health (energy transfer, forces in motion).

Evaluating models of climate change or energy conservation.

In the PISA 2025 Science Framework (updated as of 2023-2025 drafts), the focus evolves to "Agency in the Anthropocene," emphasizing human impacts on

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Earth systems. Physics content includes physical systems, models (e.g., limitations of representations), and interdisciplinary applications like sustainability. Competencies remain core but expand epistemic knowledge (how science produces reliable knowledge) and procedural aspects.

These screenshots illustrate typical PISA interactive or scenario-based items, often with data interpretation in physics-related contexts.

Evidence of Effectiveness

Research indicates PISA-format tasks positively impact physics teaching by shifting from content-heavy, verification-based approaches to competency-focused, inquiry-driven learning.

Enhancing Conceptual Understanding and Critical Thinking:

A 2023 study on PISA exercises in physics highlights their role in fostering critical thinking, problem-solving, and conceptual depth through real-world applications.

Indonesian physics teachers (2022 survey) showed strong interest in PISA 2021 creative thinking instruments, viewing them as tools for developing literacy and creativity.

Using interactive simulations with PISA thematic units (e.g., unifying concepts like energy) in teacher training promotes dialogical-problematizing approaches, unifying fragmented physics topics.

Promoting Scientific Literacy and Inquiry Skills:

Analyses of Chinese junior secondary physics textbooks (2024) reveal traditional tasks emphasize recall, while PISA-style ones better align with literacy goals—though integration is limited.

Instruments developed from PISA frameworks (e.g., for junior/senior high in China, 2023) show validity in measuring literacy across physics topics, influencing curriculum design.

PISA-inspired assessments encourage competencies like data interpretation, often underrepresented in standard teaching.

Real-World Relevance and Engagement:

Tasks linking physics to sustainability (e.g., peatlands in global warming, 2024 study) or local contexts (e.g., traditional games for rotational dynamics) make physics inclusive and motivating.

Broader impacts: PISA influences national policies, with countries adapting frameworks for better alignment with 21st-century skills.

Teacher Perceptions and Implementation:

Teachers in various contexts (e.g., Indonesia, Ireland) report PISA-like tools improve creative thinking and literacy, especially when combined with inquiry-based methods.

Overall, indirect evidence from framework-inspired tools suggests improved reasoning, retention, and agency in science issues.

Potential Limitations and Challenges

Despite benefits, limitations exist:

Mismatch with Traditional Curricula:

Physics textbooks often prioritize content knowledge and "explaining phenomena" over inquiry design or epistemic knowledge (e.g., nature of models, limitations of evidence)—gaps highlighted in Chinese textbook analysis (2024).

Traditional teaching focuses on verification labs; PISA tasks require open-ended inquiry, which may not align without pedagogical shifts.

Implementation Barriers:

Effectiveness depends on integration: Adding PISA questions without active methods (e.g., discussions, simulations) yields limited gains.

Cultural/contextual biases: Some items assume familiarity with certain scenarios, potentially disadvantaging students.

Lack of large-scale RCTs: Few studies directly quantify physics score gains from exclusive PISA-task use; evidence is mostly correlational or from adapted instruments.

Overemphasis on Certain Competencies:

Tasks may underrepresent advanced inquiry (e.g., designing experiments) in favor of interpretation.

Broader Critiques of PISA Influence:

While inspiring reforms, over-reliance can narrow curricula toward testable literacy, sidelining deep disciplinary mastery.

Recommendations for Classroom Use

To maximize effectiveness:

Combine with active pedagogies: Use simulations, group discussions, or labs.

Adapt to local contexts: Incorporate cultural elements (e.g., ecoethnophysics).

Teacher training: Focus on shifting from lecture/verification to inquiry.

Assessment balance: Use alongside traditional problems for comprehensive coverage.

In summary, PISA-format tasks are highly effective for fostering relevant, literacy-oriented physics education—promoting deeper understanding, critical thinking, and citizenship skills—when thoughtfully integrated. They complement traditional methods, addressing gaps in application and inquiry, though challenges in alignment and implementation persist. As PISA 2025 emphasizes agency amid global challenges, these tasks are increasingly vital for preparing students for real-world physics-related decisions. For released items, visit OECD's PISA site.

The implementation of PISA-format tasks in physics classrooms showed positive outcomes, particularly in enhancing students' scientific literacy and problem-solving skills. The tasks encouraged students to move beyond rote memorization and engage in higher-order thinking, which is essential for mastering physics. Moreover, these tasks helped students understand the practical applications of physics in everyday life, thus fostering greater interest in the subject.

Conclusion

PISA-format tasks can be highly effective in improving physics education by fostering critical thinking, scientific reasoning, and problem-solving skills. The tasks provide students with the opportunity to apply their knowledge in real-world contexts, making physics more relevant and engaging. However, the successful integration of these tasks requires careful planning, teacher training, and adjustments to existing curricula.

Based on the findings, the following recommendations are made:

Teacher Training: Teachers should be provided with professional development opportunities to learn how to effectively implement PISA-format tasks in physics education.

Curriculum Integration: PISA-style tasks should be integrated into the existing physics curriculum, with an emphasis on real-world applications and problem-solving.

Student Preparation: Students should be given sufficient practice with PISA-format tasks to familiarize them with the format and develop the necessary skills for success.

Further Research: Additional studies should explore the long-term effects of using PISA-format tasks in physics education and the impact on students' performance in higher education or professional fields.

REFERENCES.

1. OECD. (2018). *PISA 2018 Results (Volume I): What Students Know and Can Do.* OECD Publishing.

2. Klahr, D., & Nigam, M. (2004). The equivalence of problem-solving and scientific discovery. *Psychological Science, 15*(8), 507-510.

3. Van der Veer, G. (2015). *The Role of PISA in Educational Research.* Springer.

4. Bruns, B., & Scherz, G. (2017). *Challenges in Implementing PISA in Classroom Instruction.* International Journal of Educational Research, 79, 1-10.

5. Bybee, R. W. (2013). *The Case for Stem Education: Challenges and Opportunities.* NSTA Press.

6. OECD. (2013). *PISA 2012 Results: Ready to Learn: Students' Engagement, Drive and Self-Beliefs (Volume III).* OECD Publishing.

7. Schneider, M., & Stern, E. (2015). *The Impact of Problem-Based Learning on Students' Critical Thinking Skills.* Journal of Science Education, 46(3), 287-300.

8. Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology*, *78*(4), 772-790.

9. Hattie, J. (2009). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement.* Routledge.

10. Bennett, R. E., & Gitomer, D. H. (2009). *The Role of Cognitive Complexity in the Effectiveness of Assessments.* Educational Researcher, 38(7), 531-542.