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IMPROVING PHYSICS TEACHING METHODS IN GENERAL SECONDARY SCHOOLS BASED ON THE RISA INTERNATIONAL ASSESSMENT PROGRAM

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Abstract:
This article explores strategies to enhance physics teaching in general secondary schools, drawing on insights from the Research on Improving Systems of Education (RISE) international assessment program. It analyzes global educational challenges, particularly in developing countries, and proposes evidence-based teaching methods to improve student learning outcomes in physics. The article reviews literature on physics education, discusses innovative teaching styles, presents findings from RISE-inspired interventions, and offers practical suggestions for educators and policymakers to address the learning crisis in physics.

Keywords: Physics education, secondary schools, RISE program, teaching methods, inquiry-based learning, student engagement, educational reform, learning outcomes.

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Introduction

Physics education in secondary schools faces significant challenges globally, particularly in developing countries where students often struggle to acquire foundational skills despite increased school enrollment. The RISE program, a global research initiative, highlights that systemic inefficiencies in education systems hinder effective learning, with many students failing to achieve basic competencies in science subjects like physics. This article aims to address these challenges by proposing improvements in physics teaching methods, informed by RISE's systemic approach to educational reform. By integrating evidence-based strategies, such as inquiry-based learning and technology-enhanced instruction, educators can foster deeper understanding and engagement in physics, ultimately improving student outcomes.

Improving physics teaching methods in secondary schools, informed by the Research on Improving Systems of Education (RISE) international assessment program, requires addressing systemic challenges and adopting evidence-based, student-centered strategies. RISE emphasizes understanding education systems holistically to overcome learning crises, particularly in developing countries where foundational skills often lag despite increased enrollment. Below are recommendations tailored to physics education, drawing on RISE's insights and physics education research, with a focus on practical, scalable methods for general secondary schools.

Align Teaching with Systemic Goals for Learning Outcomes

RISE highlights that "business as usual" approaches (e.g., more spending, better-educated teachers, or additional inputs) often fail to accelerate learning outcomes significantly. For physics, this means aligning teaching methods with ambitious, measurable goals that prioritize conceptual understanding and problem-solving over rote memorization.

- Action: Use curriculum frameworks that emphasize core physics concepts (e.g., forces, energy, particles) and skills like inquiry and critical thinking, as seen in updated programs like the International Baccalaureate (IB) Diploma Programme physics course. Design assessments that test application, not just recall, using tools like the Force Concept Inventory or Brief Electricity and Magnetism Assessment (BEMA).
- RISE Insight: Systems must focus on learning, not just schooling. In physics, this means prioritizing understanding of fundamental principles over covering

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extensive content. Reduce curriculum overload by focusing on key topics like mechanics or electricity, ensuring depth over breadth. (https://riseprogramme.org/)

- Example: In Ethiopia, a study showed that simulated analogical reasoning blended with group discussions significantly improved students' physics achievement in electricity and magnetism compared to traditional methods. This approach can be adapted to align with RISE's call for innovative, system-wide strategies.

Adopt Active Learning and Inquiry-Based Methods

Physics education research consistently shows that active engagement improves conceptual understanding. RISE supports moving away from "common sense" solutions that don't work, advocating for evidence-based innovations. Inquiry-Based Science Education (IBSE) and other active learning strategies are particularly effective for physics.

- Action: Implement IBSE, where students explore phenomena through experiments, discussions, and problem-solving before formal instruction. For example, use hands-on activities like building simple circuits or measuring motion to teach concepts like voltage or kinematics.

- RISE Insight: Systemic barriers, such as teacher training or resource constraints, often hinder innovation. Address this by integrating IBSE into existing curricula with low-cost materials (e.g., slinky springs for waves, as used in inclusive Portuguese classrooms).

- Example: A comparative study between Indonesia and Ireland found that Irish physics teachers, who widely adopted IBSE, fostered better student attitudes toward physics compared to Indonesian teachers relying on direct instruction. Secondary schools can adopt hybrid models, combining IBSE with guided instruction for resource-limited settings.

Enhance Teacher Training with Pedagogical Content Knowledge (PCK)

RISE emphasizes the need for teacher support to implement reforms effectively. In physics, Pedagogical Content Knowledge (PCK)—knowledge of how to teach specific physics concepts—is critical for addressing student misconceptions and fostering engagement.

- Action: Train teachers in physics-specific PCK, focusing on common student difficulties (e.g., confusing velocity and acceleration) and strategies to address

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them (e.g., using analogies or simulations). Programs like the Rutgers Certification Program in Physical Science can serve as models.

Leverage Technology and Inclusive Resources

RISE underscores the need for audacious measures to accelerate learning. Digital tools and inclusive resources can make physics more accessible and engaging, especially for diverse learners, including those with disabilities.

- Action: Use free or low-cost digital tools like PhET Interactive Simulations to visualize abstract concepts (e.g., electric fields). For inclusive education, adopt multisensory resources, such as tactile models for visually impaired students, as tested in Portuguese middle schools.
- RISE Insight: Technology alone doesn't improve learning; it must be embedded in effective systems. Ensure teachers are trained to integrate tools meaningfully, avoiding over-reliance on tech without pedagogical grounding.
- Example: Labster's storytelling-based simulations (e.g., on collisions) engage students by connecting physics to real-world contexts, aligning with RISE's focus on making learning relevant. Schools with limited internet can use offline versions or physical models.

Conclusion

Improving physics teaching in secondary schools, guided by RISE's systemic approach, involves adopting active learning, enhancing teacher training, leveraging technology, and ensuring equity. By focusing on inquiry-based methods, real-world applications, and data-driven evaluation, schools can address the learning crisis and foster students' conceptual understanding and enthusiasm for physics. These strategies, grounded in evidence from physics education research and RISE's global insights, offer a path to transformative, sustainable improvements in physics education.

This article demonstrates that improving physics teaching in secondary schools requires evidence-based methods like IBSE, simulated analogical reasoning, and technology-enhanced learning, informed by RISE's systemic approach. While these methods show promise, their success hinges on addressing systemic barriers, such as teacher training and resource availability. To enhance physics education, the following suggestions are proposed:

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