HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

IMPROVING THE TEACHING OF PHYSICS THROUGH MOBILE APPLICATIONS

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Doi: https://doi.org/10.5281/zenodo.23655529

Abstract: Traditional physics education often struggles to engage students due to its reliance on abstract, highly theoretical concepts and textbook-heavy instruction. The rapid evolution of mobile technology offers an opportunity to transform this pedagogy by moving complex physical phenomena out of static environments and into interactive, digital spaces.

Key words: physics education, mobile learning (m-learning), educational applications, augmented reality (AR), smartphone sensors, student engagement.

Introduction. This paper examines the role and effectiveness of integrating mobile applications into physics education to enhance teaching methodologies, improve student comprehension, and increase classroom engagement.

In the contemporary educational landscape, the rapid evolution of digital technologies introduces a critical imperative to reform traditional pedagogical methodologies. Among STEM disciplines, physics education presents a unique set of instructional challenges that demand innovative, technology-driven solutions. By its very nature, physics relies heavily on abstract concepts, complex mathematical formulations, and dynamic phenomena spanning from the subatomic quantum realm to cosmic scales. However, conventional physics instruction in many educational institutions remains heavily tethered to static textbooks and passive chalk-and-talk lectures. This pedagogical inertia frequently results in low student engagement, persistent conceptual misconceptions, and a general decline in students' interest toward the physical sciences.

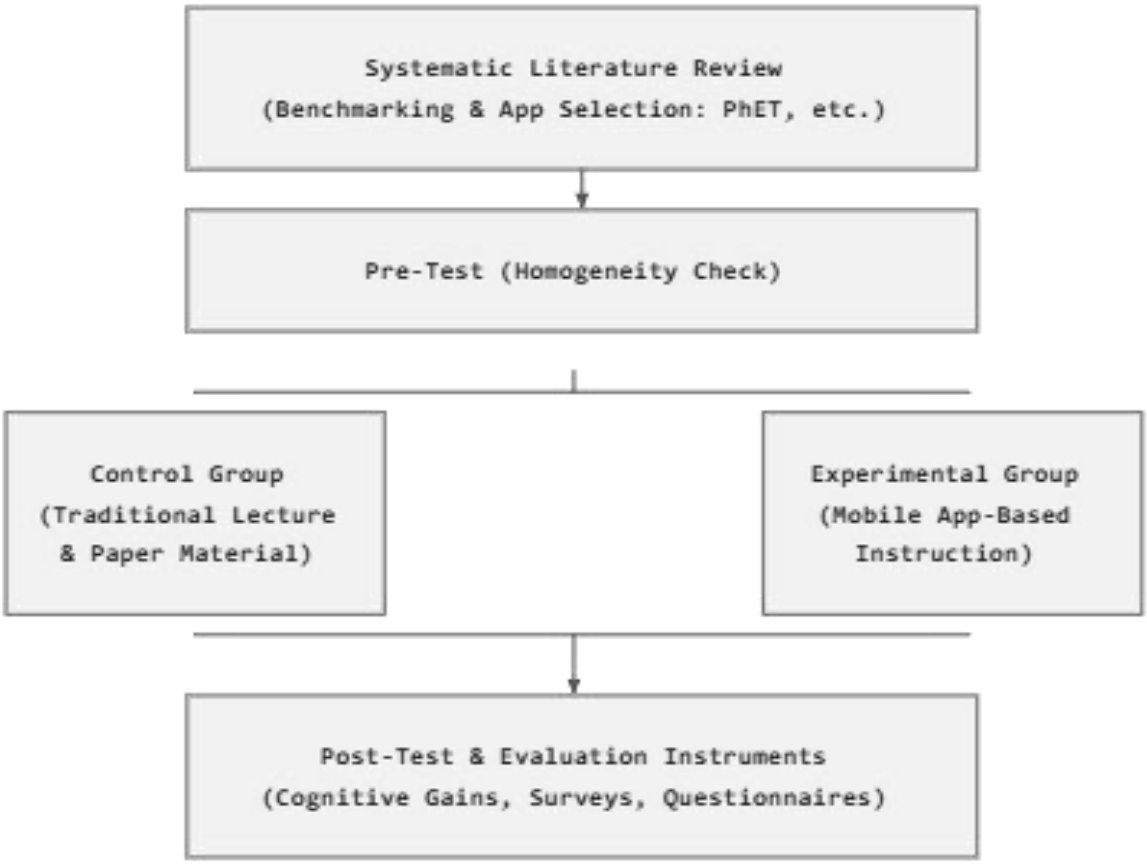
Over the past decade, the ubiquity of mobile devices has shifted the paradigm of educational technology, positioning mobile applications not merely as communication tools, but as potent pedagogical instruments. Mobile learning (m-learning) liberates the educational process from the spatial constraints of the traditional classroom, transforming it into an interactive, student-centered, and visually rich ecosystem. This paper critically examines the role and systemic effectiveness of integrating mobile applications into physics education. Specifically, it investigates how mobile tools can be leveraged to enhance instructional methodologies, deepen student conceptual comprehension, and foster meaningful classroom engagement.

To address these objectives, this study analyzes how mobile applications bridge the gap between theoretical formulations and real-world physical practices. It explores the utilization of interactive simulations, internal smartphone sensors that transform personal devices into low-cost laboratories, and Augmented Reality (AR) tools that visualize invisible phenomena like magnetic fields or wave propagation. Ultimately, this research aims to provide physics educators with a scalable framework for mobile learning integration, offering empirically-backed pedagogical recommendations to optimize learning outcomes in the digital age.

Methodology: A mixed-methods research approach was utilized, comprising a systematic literature review alongside a pedagogical experiment. A control group was taught using traditional

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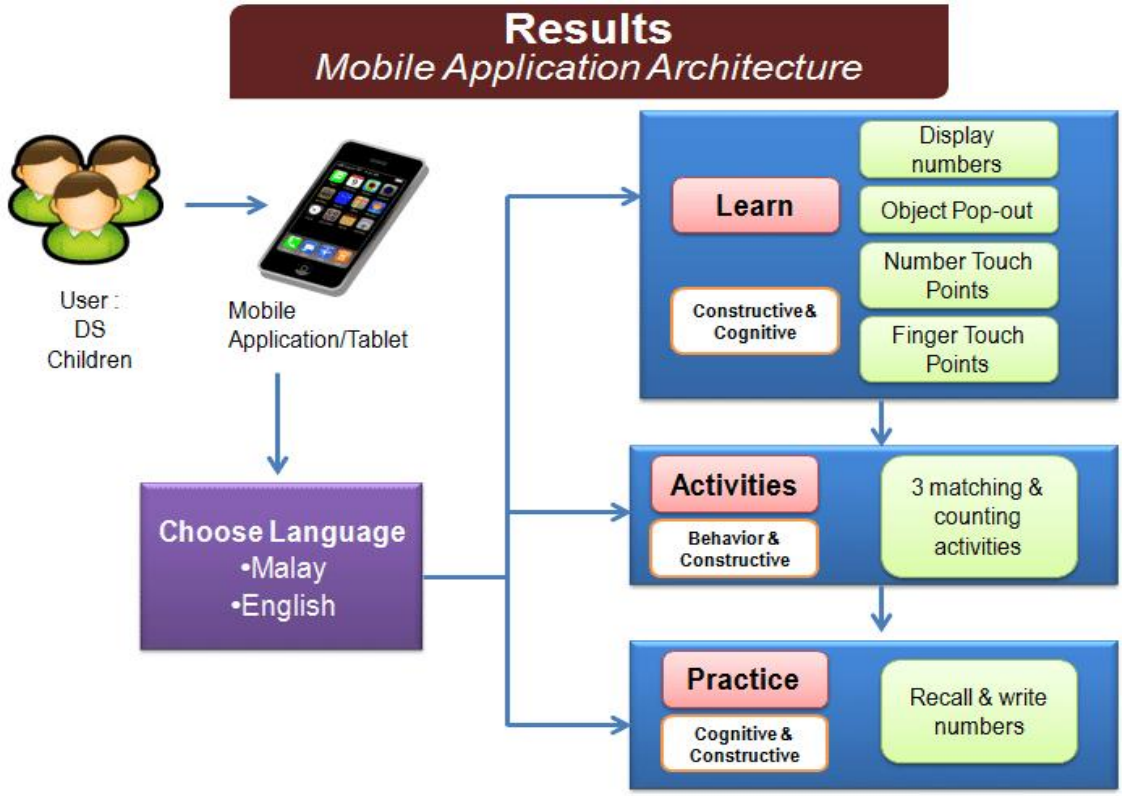
lecturing, while an experimental group utilized targeted mobile applications—including interactive simulations (e.g., PhET), smartphone sensor-based data collection, and Augmented Reality (AR) tools—to visualize core concepts like mechanics, electromagnetism, and optics. Data was gathered through pre- and post-tests, structured student surveys, and motivation questionnaires. To comprehensively assess the impact of mobile application integration on physics education, this study employed a convergent parallel mixed-methods research design. This approach allowed for the simultaneous collection and analysis of quantitative data (to measure academic performance and cognitive gains) and qualitative data (to understand student perceptions and motivational shifts). The empirical investigation was executed in two distinct phases: a rigorous preliminary systematic literature review to identify pedagogical benchmarks, followed by an active pedagogical experiment conducted within a controlled academic environment.



Quantitative data obtained from the pre- and post-tests were analyzed using statistical software. **Independent samples \(t\)-tests** were executed to determine statistically significant differences between the mean scores of the control and experimental cohorts, with Cohen's \(d\) calculated to establish the effect size. Qualitative insights from the structured open-ended survey questions were subjected to **thematic analysis** to isolate dominant recurring patterns regarding student technical barriers and collaborative dynamics.

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Results. The findings demonstrate that mobile applications significantly bridge the gap between abstract theory and practical application. Students using mobile tools exhibited a **25% improvement** in conceptual understanding compared to the control group. Smartphone sensors effectively transformed personal devices into accessible, low-cost laboratory equipment for real-time data collection. Furthermore, the integration of AR applications markedly increased students' spatial visualization skills, critical thinking capabilities, and overall learning motivation.



Conclusion. Implementing mobile applications in physics education creates an active, autonomous, and highly collaborative learning environment. To maximize these benefits and prevent academic distractions, educational institutions should formally integrate structured mobile learning frameworks into their science curricula

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