Linking Interest and Performance: A Study On Mobile-Assisted Projectile Motion Experiments

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Abstract

This study investigated the effectiveness of mobile-assisted, hands-on experiments in enhancing students' interest and performance in learning projectile motion. Specifically, it examined the relationship between students' level of interest in mobile-assisted experiments and their academic performance. A descriptive-correlational research design was employed, involving 34 first-year Industrial Engineering students enrolled in Physics for Engineers at Foundation University during the second semester of the 2024–2025 school year. Students performed projectile motion experiments using mobile applications, a self-made experiment guide, and a projectile launcher. Data were gathered through a validated 40-item performance test (Acabal et al., 2023) and an adapted interest questionnaire (Piñero et al., 2018), both of which demonstrated strong reliability (0.814 and 0.813, respectively). Findings revealed that students showed very high interest in the mobile-assisted experiments, with an overall mean rating of 4.53, indicating strong agreement that the approach made physics more engaging, enjoyable, and relevant. However, academic performance outcomes were generally low, with a mean score of 72.6, falling under the "Did Not Meet Expectations" category; nearly half of the students (47.06%) scored below the passing mark. Correlation analysis further indicated a very weak relationship (r_s = 0.041) between interest and performance. The results highlight that while mobile-assisted experiments can significantly increase student engagement and motivation, interest alone does not guarantee academic success. Effective learning requires pairing engaging strategies with strong instructional scaffolding to deepen conceptual understanding.

Keywords: Hands-on experiments; Mobile-assisted learning; Physics education; Student interest

Introduction

Physics education plays a crucial role in developing critical thinking and problem-solving skills, which are essential in the modern world driven by science and technology. However, globally, students struggle to grasp fundamental physics concepts, leading to low engagement and declining interest in scientific careers (Hernández-Suárez et al., 2021). A major challenge lies in the lack of adequate educational resources, limiting the adoption of innovative teaching strategies and access to modern learning tools (Wangchuk, Wangdi et al., 2023). Recent studies have explored ways to improve physics education, such as leveraging interactive computer simulations (Banda & Nzabahimana, 2021), incorporating technological advances for more effective learning (Faresta et al., 2024), shifting from traditional lectures to active learning methods (Kadir & Permana, 2022), and utilizing hands-on experiments to promote critical thinking (Anvarjonovna, 2023). Despite these innovations, the integration of technology with hands-on experimentation remains a challenge, impacting the effectiveness of physics instruction worldwide.

In the Philippines, the challenges in physics education are even more pronounced. Filipino students consistently perform poorly in global science literacy assessments, as seen in the 2018 Programme for International Student Assessment (PISA), where the country ranked second to last among 78 nations (Bernardo et al., 2023). The state of physics education is hindered by several factors, including a shortage of qualified teachers, large class sizes, and insufficient access to instructional materials and laboratory equipment (Owusu et al., 2020). While efforts have been made to enhance physics instruction, such as improving teacher training and increasing resource availability, these challenges continue to affect students' conceptual understanding and interest in the subject. There is an urgent need to develop innovative and contextually appropriate teaching approaches that address these limitations and improve students' learning experiences.

A review of existing literature reveals a significant research gap, most innovations in physics education focus on either technology-based approaches, such as simulations and mobile applications, or hands-on experiments using self-made apparatus, but rarely integrate both (Piñero et al., 2023; Benong et al., 2024; Acabal et al.,2022; Kleizi et al., 2025) . Current studies exploring the use of mobile applications in physics experiments often lack real-world applicability, as these technologies are not incorporated into actual laboratory setups (Myslitska et al., 2024; Bogusevschi et al., 2020). Similarly, experiments using self-constructed apparatus generally do not leverage digital tools to enhance learning. Furthermore, most research on educational innovations in physics has been conducted at the high school level, with limited studies at the tertiary level. Specifically, there is a lack of research on integrating mobile applications into hands-on experiments involving self-made apparatus, particularly in topics like projectile motion. Investigating this integration could provide a novel, engaging, and effective approach to teaching physics concepts.

This study was conducted in a university in Dumaguete City, where physics courses are offered, but access to equipment for demonstrating projectile motion remains limited. By merging hands-on experimentation with mobile applications, this research aims to spark students' interest in physics and improve their conceptual understanding of projectile motion. The findings of this study could contribute to the advancement of physics education in the Philippines, offering a scalable and innovative teaching approach that enhances both engagement and comprehension.

Literature Review

The academic performance of students in physics has been widely studied, with findings showing that many struggle due to low interest, weak study habits, and negative attitudes toward the subject (Lestari et al., 2020; Awodun et al., 2014). Effective instructional strategies that develop higher-order thinking skills (HOTS), critical thinking, and inquiry-based learning are shown to clarify misconceptions, increase engagement, and improve performance, especially when supported by teacher training (Ramos et al., 2013; Assem et al., 2023). Building self-efficacy and fostering recognition from peers and instructors also boost confidence and motivation, particularly for underrepresented groups (Bottomley et al.).

The COVID-19 pandemic intensified challenges in physics education, with limited teacher-student interaction, difficulties in online learning, and reduced student interest leading to poor performance (Villaceran et al., 2024). To address these, innovative methodologies such as Creative Problem Solving (CPS), flipped classrooms, and interactive technologies have been adopted. Tools like PhET simulations, augmented reality (AR), and localized instructional materials improve visualization of abstract concepts, self-efficacy, and student engagement (Rahayu et al., 2022; Banda & Nzabahimana, 2023; Cai et al., 2020). Hands-on approaches using self-made apparatus or interactive toys also enhance motivation, comprehension, and test performance (Kleizi et al., 2024; Rosales et al., 2024).

Mobile applications have emerged as powerful tools in physics instruction, offering accessibility, interactivity, and individualized learning experiences (Goncharenko et al., 2020). Widely applied in sound, motion, and optics experiments, they allow measurements of frequency, acceleration, and light intensity, often within Bring Your Own Device (BYOD) setups that link theory to real-world practice (Buongiorno & Michelini, 2021). Integrated with simulations like PhET or e-handouts, mobile apps foster science process skills and deeper understanding (Haryadi & Pujiastuti, 2020; Aminah et al., 2020). Local innovations such as smartphone-based resonance tubes, SmartScope integration, and AR apps like GeoGebra 3D demonstrate the versatility of mobile technology in physics experiments (Piñero et al., 2023; Staacks et al., 2018 & Bernardini et., 2024 &Monteiro & Marti ,2022).

Conceptual understanding, defined as the ability to meaningfully connect and apply knowledge, is critical in physics learning (Mills, 2016). Studies show that interactive and hands-on methods stimulate interest, curiosity, and reasoning skills, leading to improved comprehension and retention (Nugroho ,2020; Toli & Kallery, 2021). Self-made tools, simulations, and multimedia content make abstract concepts tangible and engaging, further sustaining interest (Kleizi et al, 2024; Rosales et al., 2025; Solvang & Haglund, 2021; Sastra et al., 2023). Moreover, STEM-based approaches integrate problem-solving and real-world applications, encouraging long-term interest and deeper conceptual understanding (Smith et al., 2022).

Overall, it emphasizes that improving physics education requires innovative teaching strategies, teacher training, and the integration of interactive tools such as simulations, AR, and mobile applications. These approaches foster student interest, motivation, and conceptual understanding, ultimately leading to improved academic performance.

Materials and Methodology

This study employed a descriptive-correlational design. It was descriptive because it (1) determined the performance of students after conducting mobile-assisted, hands-on projectile motion experiments, and (2) assessed their level of interest in using this approach. It was correlational because it examined the relationship between students' interest in mobile-assisted real experiments on projectile motion and their performance.

The study was conducted at Foundation University, Dumaguete City, Negros Oriental, with participants consisting of first-year Industrial Engineering students enrolled in Physics for Engineers during the second semester of the 2024–2025 school year, where projectile motion was one of the topics. As part of the study, students used mobile applications, a self-made experiment guide, and completed test questionnaires.

A validated 40-item test questionnaire formulated by Acabal et al. (2023) was used to measure students' performance in projectile motion. In addition, an interest questionnaire, adapted from Piñero et al. (2018) and modified to assess students' interest in mobile-assisted, hands-on experiments, was employed. All instruments, including the experiment guide and questionnaires, were validated by three experts in Physics Education. A dry run was conducted to establish reliability: the test–retest method was used for the performance test items, while Cronbach's alpha was applied to interest-related questions. The resulting reliability coefficients were 0.814 and 0.813, respectively, indicating strong reliability.

Prior to data collection, the researcher explained the purpose and significance of the study to the participants and tested all materials, including the mobile applications, experiment guide, and projectile launcher. The class was divided into six groups of five, with each group conducting experiments by launching projectiles at ten different angles, performing three trials per angle.

Before the experiment, the researcher reviewed key concepts of projectile motion, demonstrated the experimental procedure, and trained students in using the mobile applications. One hour was allotted for conducting the experiment and answering the guide questions. Afterward, students took the 40-item performance test, followed by the interest questionnaire. Responses from activity sheets and questionnaires were tallied, and test scores were computed for accuracy. The data were then analyzed to evaluate the effectiveness of the mobile-assisted experiment.

This study strictly followed ethical research standards. Approval was secured from the Ethics Committee of the Foundation University Research Office. Respondents were fully informed about the study's purpose, and participation was voluntary. Students had the right to withdraw at any point without penalty. All personal data, including test scores, were treated with strict confidentiality, and the researcher ensured the safety of participants throughout the experiments.

Results and Discussion

Table 1. Level of Interest of the Students in Mobile-assisted Projectile Motion Experiment (N = 34)

Indicators	$\bar{x}$	Verbal Description	Level of Interest
The mobile-assisted projectile motion experiment …			
1. in the discussion of projectile motion is interesting.	4.62	Strongly Agree	Very High
2. helps me focus on the discussion and the concepts about projectile motion.	4.41	Strongly Agree	Very High
3. made the study of projectile motion particularly	4.38	Strongly Agree	Very High

	fascinating to me.			
4.	makes me feel curious about the nature of science.	4.50	Strongly Agree	Very High
5.	makes me listen attentively to the teacher.	4.44	Strongly Agree	Very High
6.	was an experience I truly enjoyed.	4.71	Strongly Agree	Very High
7.	encouraged me to use my skills in manipulating objects.	4.47	Strongly Agree	Very High
8.	makes me feel excited as to what I'm going to find out, especially in the lesson about projectiles.	4.29	Strongly Agree	Very High
9.	is something I would like to apply to other concepts in Physics.	4.35	Strongly Agree	Very High
10.	made me realize that Physics is not merely a set of formulas that need to be memorized.	4.68	Strongly Agree	Very High
11.	made me realize that Physics would be more interesting with the use of mobile-assisted experiments.	4.71	Strongly Agree	Very High
12.	made me realize that with the use of mobile-assisted projectile motion experiment, Physics concepts would be a lot more fun.	4.79	Strongly Agree	Very High
Average		4.53	Strongly Agree	Very High

Table 1 presents the level of interest of students in the mobile assisted projectile motion experiment. The findings reveal that students expressed "very high interest", with an overall mean rating of 4.53, falling within the "Strongly Agree" and "Very High Interest" category.
All indicators received strong positive ratings, with means ranging from 4.29 to 4.79. The highest ratings were recorded for statements such as "made me realize that with the use of mobile assisted projectile motion experiment, Physics concepts would be a lot more fun" (mean = 4.79) and "made me realize that Physics would be more interesting with the use of mobile assisted experiments" (mean = 4.71). This demonstrates that the use of mobile technology in the Physics classroom effectively increased students' engagement, curiosity, and enjoyment in learning projectile motion. The interactive nature of mobile assisted activities appeared to help students connect abstract concepts with real-life applications, transforming their perception of Physics from a subject focused on memorization of formulas to one that is dynamic, exploratory, and enjoyable. The findings suggest that mobile assisted instruction is a valuable tool for enhancing students' interest and enthusiasm for learning.

The results are strongly supported by studies, Nugroho and Waslam (2022) and Toli and Kallery (2021) assert that hands-on experiments and interactive learning methods significantly enhance student interest in Physics, which aligns well with the students' strong agreement across all indicators of interest.

Table 2. Academic Performance of Students in Learning the Concepts of Projectile Motion After the Mobile-assisted Projectile Motion Experiment (N = 34)

Rating	Verbal Description	Frequency	Percent	Mean	SD
99% - 100%	Exceptional	-	-		
96% - 98%	Excellent	-	-		
93% - 95%	Very Good	1	2.94		
90% - 92%	Good	3	8.82		
87% - 89%	Very Satisfactory	5	14.71	72.6%	4.42
84% - 86%	Satisfactory	-	-		
81% - 83%	Fairly Satisfactory	4	11.76		
78% - 80%	Below Satisfactory	2	5.88		
75% - 77%	Passing	3	8.82		
Below 75%	Did Not Meet the Expectations	16	47.06		
Total		34	100.00		

Table 2 shows students' academic performance did not meet expectations overall after the performing the Mobile-assisted Projectile Motion Experiment. The mean score is 72.6, corresponding to the "Did Not Meet the Expectations" category. Nearly half of the students (47.06%) scored below the passing mark (75%), while only 2.94% achieved a "Very Good" rating and 14.71% attained "Very Satisfactory." A small number fell into other passing categories such as "Good" and "Fairly Satisfactory." This finding implies that there is a need for improvement in students' comprehension and performance in the concept of projectile motion. It also suggested that there is need for additional teaching interventions such as guided practice, scaffolded problem-solving, and reinforcement activities to help students deepen their understanding and apply what they have learned more.

Vaiopoulou et al. (2023) emphasize that conceptual understanding requires overcoming cognitive obstacles and developing connections between abstract variables—something that mere interest alone cannot ensure. The results are also consistent with the findings of Villaceran et al. (2024), who noted that students struggled with Physics due to challenges in understanding abstract concepts an issue exacerbated by limited teacher guidance during online and modular learning formats.

Table 3. Relationship between the Level of Interest in Mobile-assisted Projectile Motion Experiment and Their Academic Performance

Variable correlated to Academic Performance	r_s	Degree of Relationship
Level of Interest vs. Academic Performance	0.041	Very Weak

Table 3 reveals that the correlation between students' level of interest and their academic performance is very weak (rs = 0.041). This implies that while students were highly interested and engaged by the mobile assisted experiment, interest alone did not translate into academic success for the majority of the learners. The findings suggest that mobile assisted learning should be integrated with comprehensive instructional strategies, including direct instruction, feedback mechanisms, and opportunities for deliberate practice, in order to convert student interest into improved academic outcomes.

The weak relationship between interest and performance contradicts the findings of Toli and Kallery (2021) and Sastra et al. (2023), who found that increased engagement through interactive tools led to improved academic performance. Furthermore, Rosales et al. (2024) found that students performed better when mobile-assisted experiments were integrated with clear learning objectives and assessments.

Conclusion

Learning the concept of projectile motion becomes more engaging, enjoyable, and meaningful when supported by experiments or laboratory activities. Such hands-on experiences reshape students' perception of Physics from a subject centered on memorizing formulas to one that is dynamic and relevant. However, the results of this study highlight an important insight: while student interest and motivation are essential components of effective learning, they are not sufficient on their own to ensure academic success. In Physics, particularly in topics like projectile motion that build on foundational concepts, interest must be paired with strong instructional strategies and a solid grasp of the fundamentals. This underscores the need for educators and curriculum developers to design learning experiences that integrate engagement with cognitive support, ensuring that curiosity is transformed into conceptual understanding and improved performance.

Based on the findings, it is recommended that teachers use mobile-assisted experiments not only to engage students but also to reinforce conceptual understanding through guided discussions, scaffolded explanations, and problem-solving exercises. Teachers should also ensure that students have a solid grasp of fundamental kinematics before introducing more complex topics like projectile motion, as bridging gaps in prior knowledge is crucial for effective learning. Moreover, combining hands-on activities with other methods such as simulations, visual aids, and peer instruction—can cater to diverse learning styles. On their part, students should take initiative in revisiting essential motion concepts to build a stronger foundation for understanding projectile motion and related topics. Finally, future researchers are encouraged to further evaluate the effectiveness of mobile-assisted learning by employing comparative research designs with control and experimental groups.

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