Gamified Approach in Strategic Intervention Material on Students' Academic Achievement and Interest among Grade 12 Physics

Alicia G. Amper[1], Ehlrich Ray J. Magday[2], Aprell L. Abellana[3]

[1]Bukidnon National School of Home Industries, Philippines

[2,3]Central Mindanao University, Philippines

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ABSTRACT

As the world becomes more digital, gamification has emerged as a promising approach to enhancing students' learning experiences. Still, many senior high school students in the Philippines face challenges with their academic performance and maintaining interest in Physics. This study examined the effectiveness of a Gamified Strategic Intervention Material (GSIM) on the academic achievement and interest of Grade 12 Science, Technology, Engineering, and Mathematics (STEM) students at Bukidnon National School of Home Industries. It contributes to the limited research on the use of gamified methods in Philippine Physics education. The main goals were to assess students' academic achievement and interest across three areas: Feelings, Value, and Re-engagement, and to identify differences between students using GSIM and those who did not. Using a quasi-experimental pretest-posttest non-equivalent groups design with 93 Grade 12 STEM students divided into experimental and control groups, the study found that the GSIM group scored significantly higher on posttests than the non-GSIM group. The GSIM group also showed greater interest across all three dimensions, with large-to-very-large effect sizes in Value and Re-engagement. While these improvements are evident, the GSIM group's overall interest reached High Interest, and many students still fall short of expected achievement levels. These findings show that adding gamified features to Strategic Intervention Materials can successfully boost both understanding and interest. By consistently applying gamification in teaching approaches, educators can support students' learning experience and foster a deeper, more enduring interest in Physics.

Keywords: Gamification, Gamified Strategic Intervention Material, academic achievement, interest, STEM students

INTRODUCTION

Physics holds a significant role in the Philippine curriculum, aligned with the Department of Education’s Enhanced Basic Education Program goal of producing scientifically literate and globally competitive graduates (Republic Act No. 10533, 2013). Despite this strategic importance, persistent student underperformance in the subject remains a critical concern. As a General Physics teacher for nine years, the researcher has consistently observed that 20–26% of students in each section fail to meet learning standards, a trend corroborated by national and international assessments. The 2022 Programme for International Student Assessment (PISA) ranked the Philippines near the bottom in Science, Mathematics, and Reading (OECD, 2023), while the 2023 National Achievement Test (NAT) revealed that public high school students in the Division of Bukidnon scored an average of only 36.82 in science, with the Bukidnon National School of Home Industries (BNSHI) scoring even lower at 35.29 (DepEd, 2023). This ongoing underperformance is often attributed to the abstract nature of physical concepts, heavy reliance on mathematics, and limited connection to real-life contexts, which often lead to low student engagement and weak academic outcomes (Pavlin-Bernardić, Šarić, & Jokić, 2025).

Fostering student interest is essential for meaningful learning. Educational psychology differentiates between situational interest, a temporary excitement triggered by environmental factors, and lasting personal interest, which is a persistent tendency to engage with content. Under the right conditions, situational interest can develop into personal interest (Hidi & Renninger, 2006). When students find academic subjects engaging, they pay closer attention, remain more persistent, and invest more cognitively, resulting in better understanding and improved academic outcomes (Harackiewicz, Smith, & Priniski, 2016). In Physics, interest is especially critical because its complex concepts and mathematical rigor often lead students to avoid the subject unless they see it as meaningful and engaging. Therefore, developing effective teaching strategies to spark and sustain situational interest and to foster long-term personal interest remains a key challenge for science educators.

One promising pedagogical approach that directly addresses how interest develops is gamification. This involves intentionally incorporating game design elements such as points, badges, leaderboards, challenges, meaningful narratives, and immediate feedback into non-game settings (Seaborn & Fels, 2015). When well-designed, gamification fulfills basic psychological needs for autonomy, competence, and relatedness, which self-determination theory considers vital for intrinsic motivation and lasting interest (Ryan & Deci, 2017). Increasing empirical evidence supports this link. Zhang et al. (2022) showed that game-based learning can effectively ignite and sustain situational interest through increasingly complex challenges, drawing on Hidi and Renninger's four-phase model of interest development. Richter and Kickmeier-Rust (2025) observed that gamification significantly increased student engagement and motivation in Physics, with students demonstrating greater time on task and higher performance under gamified conditions compared to non-gamified conditions. Similarly, Kua, Dewa, and Lobe (2025) reported a large effect size on students' attention and satisfaction with motivation during a Kahoot! activity. -based gamified Physics lesson at the junior high level. In the Philippines, Tablatin et al. (2023) used a Minecraft-based learning environment and reported notable increases in students' determination to pursue STEM careers. A recent study in Northern Mindanao (2026) also found that leaderboard-based gamification boosted students' personal motivation and willingness to tackle challenging Mathematical Physics content.

In the Philippine setting, Strategic Intervention Materials (SIMs) have been widely recognized as effective tools for remediating students' least-mastered competencies and improving science learning outcomes (Manlapig, Cruz, & Fernandez, 2024; Payot, de la Cruz, & Laperal, 2022). However, existing SIMs are predominantly designed to address cognitive deficits through re-teaching and repetitive practice, often lacking deliberate features to cultivate student interest. This represents a significant gap, as a key reason students fail to master competencies may lie in their diminished interest and emotional disconnection from the subject matter. Furthermore, while international scholarship on gamification in science education has expanded considerably, local studies that systematically examine its effects on student interest, as distinct from general engagement or motivation, remain limited within the Grade 12 Physics context (Amado & Roleda, 2019; Tolentino & Roleda, 2017). Existing Philippine studies confirm that gamified approaches can boost participation and performance (Benben & Bug-os, 2022; Maragañas & Dioso, 2025), but few have investigated whether such interventions can transform initial excitement into deeper, content-focused interest.

In response to the twin problems of low proficiency and low student interest in Physics, this study investigated the effectiveness of a Gamified Strategic Intervention Material (GSIM) in improving the academic performance and interest of Grade 12 Science, Technology, Engineering, and Mathematics (STEM) students. The GSIM strategically embedded gamification elements, meaningful narratives, escalating challenges, immediate feedback, fail-safe environments, and interactive collaboration within the structured remediation format of a SIM, deliberately designed to trigger and sustain situational interest while simultaneously targeting the least-mastered competencies in General Physics.

Objectives

This study aimed to investigate the effects of Gamified Strategic Intervention Material on students' academic achievement and interest in the Grade 12 STEM Physics class of Bukidnon National School of Home Industries during the 2025-2026 school year. Specifically, it aimed to:

1. Determine the students' level of academic achievement as exposed to the GSIM and those exposed to non-GSIM in terms of pretest and posttest.

2. Assess the students' interest in Physics before and after exposure to GSIM and those exposed to non-GSIM in relation to: Feelings; Value; and Re-engagement.
3. Ascertain the significant difference in the students' level of academic achievement as exposed to the GSIM and those exposed to non-GSIM in terms of pretest and posttest.
4. Determine the significant difference in the students' interest in Physics before and after exposure to GSIM and those exposed to non-GSIM in relation to: Feelings, Value, and Re-engagement.

METHODOLOGY

Research Design

This study employed a quasi-experimental design to evaluate the impact of the GSIM on students' academic performance and interest in Physics. It included two (2) intact Grade 12 STEM classes at Bukidnon National School of Home Industries, North Poblacion, Maramag, Bukidnon. One (1) class is exposed to a GSIM-based Physics lesson, while the other is exposed to a non-GSIM Physics class.

Locale of the Study

The pilot testing of the research tools was conducted at Central Mindanao University (CMU) in Musuan, Maramag, Bukidnon, involving second-year Bachelor of Secondary Education Science majors who had completed their General Physics coursework. The study was conducted at the Bukidnon National School of Home Industries (BNSHI) in Maramag, Bukidnon. The target population consisted of approximately 93 Grade 12 Science, Technology, Engineering, and Mathematics students from two intact sections, designated as the experimental and control groups, during the 2025–2026 school year.

Participants of the Study

The participants were two (2) intact, heterogeneous Grade 12 STEM sections enrolled in General Physics II at Bukidnon National School of Home Industries, North Poblacion, Maramag, Bukidnon, for S.Y. 2025-2026. The sections were randomly assigned to the experimental group (GSIM, n = 46) and the control group (non-GSIM, n = 47). Both groups were heterogeneous in composition and shared similar academic characteristics.

Research Instrument

This study utilized GSIM and two instruments: the Academic Test and the Student Interest Questionnaire. The primary instrument for this study is the GSIM, which was specifically designed and developed by the researcher to enhance learning in Physics. The control group received the same content topics (direct-current circuits: resistors in series and parallel, Kirchhoff's rules, and R-C circuits) using a non-gamified version of the Strategic Intervention Material (SIM). This non-GSIM followed the same card structure (Guide, Activity, Assessment, Enrichment, Reference) but included no gamification elements, such as points, badges, leaderboards, or immediate feedback. Instruction for the control group was delivered through self-paced reading of the non-GSIM cards, followed by individual completion of exercises, consistent with typical SIM implementation in Philippine science classrooms (Manlapig et al., 2024). The only difference between groups was the presence or absence of gamified features; all other conditions (time on task, topic coverage, teacher, and assessment instruments) were held constant.

For the academic assessment, a teacher-made questionnaire for General Physics II (Direct Currents) was used to evaluate students' achievement in the subject. The test was administered to both groups to measure their academic achievement and consisted of a pretest and a posttest. A one-way Table of Specifications (TOS) was created to ensure the content aligned with Bloom's taxonomy of Learning Domains. Science experts validated the questionnaire to ensure the test items effectively measured students' knowledge and skills. The initial 60-item academic test was pilot tested with 32 second-year Bachelor of Science in Education science majors at Central Mindanao University who had completed General Physics. Item analysis used specific criteria: (a) item difficulty index between 0.30 and 0.80, (b) item discrimination index (D) ≥ 0.25, and (c) point-biserial correlation (rpb) ≥ 0.20. Items that did not meet at least two of these criteria were eliminated, resulting in 30

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retained items. The final test of 30 items had a Cronbach's alpha of 0.751, indicating good reliability. The TOS ensured that the remaining items covered the topics (series/parallel circuits, Kirchhoff's rules, R-C circuits) across different levels of Bloom's taxonomy.

The students' level of academic achievement was measured using the following scales, as per DepEd Order No. 8, series of 2015.

Percentage Equivalent	Descriptive Rating	Qualitative Description
90% and above	Outstanding	Goes beyond the core requirements in knowledge, skills, and understanding by automatically and flexibly transferring them through real-world tasks.
85% – 89%	Very Satisfactory	Develop core knowledge, skills, and understanding that can be applied automatically and flexibly through real-world tasks.
80% – 84%	Satisfactory	Acquire core knowledge and, with minimal guidance from the teacher or with peer support, demonstrate this understanding through real-world tasks.
75% – 79%	Fairly Satisfactory	Has minimal knowledge, skills, and understanding but requires assistance.
74% and below	Did Not Meet Expectation	Difficulties with understanding, prerequisites, and core skills indicate that these areas have not been sufficiently developed to support comprehension.

The researcher adapted a tool based on Knekta et al. (2020) to evaluate students' interest in science through three sub-components: Feelings, Value, and Re-engagement. After pilot testing with 37 participants and analyzing the items, three were removed because they were not relevant to the context, specifically, items referencing access to print resources and physics clubs, which are unavailable to senior high school students in rural Bukidnon. The final version included 17 items divided into three subscales: Feelings (7 items), Value (5 items), and Re-engagement (5 items). All items were rated on a 5-point Likert scale. For the main sample of 93 students, internal consistency was assessed using pretest responses, yielding a high reliability for the total scale ($\alpha = 0.890$). The subscales also showed acceptable reliability: Feelings ($\alpha = 0.884$), Value ($\alpha = 0.724$), and Re-engagement ($\alpha = 0.705$). The average scores from pretest and posttest were analyzed and interpreted according to the scale provided below.

Scale	Range	Descriptive Rating	Qualitative Description
5	4.20-5.00	Strongly Agree	Very High Interests (VHI)
4	3.40-4.19	Agree	High Interests (HI)
3	2.60-3.39	Undecided	Moderate Interests (MI)
2	1.80-2.59	Disagree	Low Interests (LI)
1	1.0-1.79	Strongly Disagree	Very Low Interests (VLI)

Data Gathering Procedure

This study was reviewed and approved by the Research Ethics Committee of Central Mindanao University. Written informed consent was obtained from all participating students, and for minors under 18, an assent form was signed by the minors and their parents or legal guardians. Participants were informed of their right to withdraw at any time without penalty, and all data were anonymized prior to analysis. A formal letter was sent through the Dean of the College of Education, CMU, to request permission to conduct a pilot test of the survey questionnaires with second-year Bachelor of Secondary Education Science majors. The pilot test was successfully conducted with 32 students. Afterward, a letter of permission was sent to the school's division superintendent and the secondary school principal of Bukidnon National School of Home Industries, requesting permission to conduct the research study. Two heterogeneous classes of Grade 12 STEM students were randomly selected. Then, a consent letter was provided to study participants to ensure they were informed and willing to participate. The researcher conducted an orientation with the participants on how the GSIM was implemented. The groups were given the students' interest in science scale before the implementation. The experiment was conducted during the fourth quarter of the second semester of S.Y. 2025-2026. The posttests were administered to the class after completing the topics to assess students' academic achievement, and the study used the "How to Gamify?" model by Abuton et al. (2025), based on Morschheuser et al. (2017).

Statistical Techniques

The data were analyzed using descriptive statistics, such as the mean, median, and standard deviation, to examine students' levels of academic achievement and engagement in Physics. Analysis of Covariance (ANCOVA) was used to analyze any significant differences in students' academic achievement and engagement in Physics between those exposed to GSIM and those exposed to non-GSIM, controlling for pretest and posttest scores.

RESULTS AND DISCUSSIONS

Students' Academic Achievement

Table 1 displays students' academic achievement levels in the GSIM and Non-Gamified Strategic Intervention Material (non-GSIM) groups, based on pretest and posttest scores. Both groups received the intervention, using their respective materials as the main teaching tools during lessons. The data show that, in the pretest, both groups performed poorly, with all students in the lowest category, "Did Not Meet Expectations" (DNME). Specifically, the GSIM group had an overall mean score of 37.61% in the pretest and improved to 62.03% in the posttest. The non-GSIM group scored 37.02% on the pretest and 55.18% on the posttest. Both groups started with similarly low achievement levels. After the intervention, both showed improvement, but students exposed to GSIM performed better than those in the non-GSIM group. This suggests that the gamified nature of GSIM contributed to better learning outcomes beyond the effect of the new instructional strategy.

Table 1. Level of Academic Achievement in GSIM and Non-GSIM Groups

Percentage Equivalent	**GSIM**				**Non-GSIM**				**Descriptive Interpretation**
	Pretest		**Posttest**		**Pretest**		**Posttest**		
	f	%	f	%	f	%	f	%	
90% and above	0	0	1	2	0	0	0	0	Outstanding
85% – 89%	0	0	4	9	0	0	2	4	Very Satisfactory
80% – 84%	0	0	11	24	0	0	4	9	Satisfactory
75% – 79%	0	0	11	24	1	2	7	15	Fairly Satisfactory
74% and below	46	100	19	41	46	98	34	72	Did Not Meet Expectation
Overall MPS	37.61 (DNME)		62.03 (DNME)		37.02 (DNME)		55.18 (DNME)		

The findings show that both groups initially had low academic achievement, establishing a baseline for comparison before the intervention. According to Coletta and Steinert (2020), students' low performance in Physics was due to the subject's prior-knowledge-based, mathematics-oriented nature and to learning experiences. They argued that prior knowledge and reasoning skills influence learning gains more than the specific teaching methods used. This explains the results in both groups, which did not meet expectations. Evidence suggests that students were adversely affected by school closures and class suspensions during the intervention (Doromal, 2026; Maramag LGU, 2026). Additionally, they faced challenges with self-learning modules, as Yunzal (2024) noted that students struggled to adapt to modular distance learning in Physics, especially in identifying learning needs and completing tasks.

Following the GSIM intervention, the gamified group showed greater improvement than the non-GSIM group. However, the MPS remained in the DNME, with 59% shifting from DNME to an average rating ranging from Fairly Satisfactory to Outstanding. The significant improvement in the GSIM group's posttest achievement is consistent with evidence that carefully aligned curriculum materials and assessments promote higher performance among basic education learners, particularly when problem-solving competencies are explicitly targeted (Abellana et al., 2024). Meanwhile, the non-GSIM group had slight gains, with only 28% progressing from Fairly Satisfactory to Very Satisfactory. These results suggest that gamification boosted the effectiveness of the SIM as an instructional approach, leading to improved learning outcomes compared to non-gamified teaching.

Recent research supports these findings. Beltozar-Clemente and Díaz-Vega (2024) showed that integrating gamification and ChatGPT into a physics course significantly boosted students' academic performance. Likewise, Abuton et al. (2025), Gaurina et al. (2025), and Richter and Kickmeier-Rust (2025) found that embedding gamification into daily instruction, rather than using it as a supplement, leads to meaningful improvements in learning. Malayao et al. (2026) proved that gamifying mathematical physics through leaderboard tracking and student feedback improved learning outcomes. In the Philippines, Benben and Bug-os (2022) and Maragañas and Dioso (2025) found that gamified materials outperform traditional methods, such as non-gamified formative assessments and lecture-based teaching, in science and math. Maguate and Rabacal (2025) also highlighted that systematic implementation of school-based interventions, including gamified approaches, can positively influence teaching performance and student achievement in public secondary schools.

Despite efforts, the results show that several GSIM students are not meeting expectations (DNME). Several factors contribute to this outcome. For instance, Payot et al. (2022) noted difficulties in implementing strategic intervention materials in Philippine science classrooms, including limited time, large class sizes, and varying levels of student readiness. Additionally, weather-related disruptions, as recorded in Maramag during February 2026 (Doromal, 2026; Maramag LGU, 2026), along with the Department of Education's acknowledgment of up to 53 lost school days in one academic year (Philippine News Agency, 2026), further complicate these challenges. Theoretically, Vygotsky's (1978) Zone of Proximal Development suggests that although gamified instruction can support learning, students who are significantly behind may still need more intensive, personalized assistance. Implementation hurdles, missed school days, and insufficient individualized support are key factors in low academic performance, leading the Department of Education to recommend remedial and supplementary materials to address these learning gaps.

Students' Interest

Feelings

Table 2 presents the posttest mean scores for students' interest in Physics, reflecting their feelings after experiencing both the GSIM and non-GSIM approaches. The GSIM group achieved a total mean score of 3.38 (MI), whereas the non-GSIM group scored 3.16 (MI). The highest mean for the GSIM group was in "I generally have fun when I am learning physics topics" (M = 3.70, HI), and the lowest was in "After a long weekend or vacation, I look forward to getting back to physics classes" (M = 3.04, MI). The non-GSIM group's highest and lowest scores followed a similar pattern (M = 3.34, MI, and M = 2.87, MI, respectively). The GSIM group had two HI indicators, while the non-GSIM group had none.

Table 2. Students' mean scores on the level of interest in relation to feelings

Indicators	**GSIM**		**Non-GSIM**	
	Mean	**Qualitative Description**	**Mean**	**Qualitative Description**
I generally have fun when I am learning physics topics.	3.70	HI	3.34	MI
I am happy working on physics topics.	3.65	HI	3.30	MI
I like to study physics primarily because of the interesting	3.52	HI	3.32	MI

subject matter.				
Working with the subject matter and problems of physics is among my favorite activities.	3.39	MI	3.13	MI
Being involved in physics classes puts me in a good mood.	3.26	MI	3.15	MI
like reading material about physics.	3.07	MI	3.04	MI
After a long weekend or vacation, I look forward to getting back to physics classes.	3.04	MI	2.87	MI
Overall Mean	3.38	MI	3.16	MI

The higher average score for the GSIM group indicates that gamified elements such as interactive challenges and instant feedback effectively increased students' emotional engagement with Physics. This supports the idea that gamified learning can ignite situational interest by making academic tasks more enjoyable (Gianni & Antoniadis, 2023). The findings also align with Sanchez et al. (2025), who noted that gamified teaching in Grade 12 Physical Science "draws their interest" and promotes more meaningful learning. Nonetheless, the MI classification for both groups indicates these positive emotions did not reach high-interest levels. The lowest scores, related to students' anticipation of returning to Physics class, suggest that the transition from situational to enduring individual interest was not fully realized, a shift that requires continuous exposure to interest-rich environments (Zhang et al., 2022).

These findings are consistent with Korlat et al. (2024), who observed that game-based teaching in secondary school Physics increases students' interest and self-confidence. They also support Kua et al. (2025), who found that gamification significantly improves learners' attention and satisfaction. In the Philippine context, Malayao et al. (2026) showed that gamified leaderboards boosted motivation and engagement among students in Northern Mindanao studying Mathematical Physics. Gianni and Antoniadis (2023) further noted that students appreciated gamified approaches, finding learning to be more enjoyable and engaging. Overall, the GSIM slightly enhanced students' attitudes toward Physics, as reflected by higher mean scores and two HI indicators. However, fostering a deeper, self-sustaining interest in Physics might require longer-term implementation of gamified strategies.

Value

Table 3 shows the posttest mean scores of students' interest in Physics, reflecting their perceived value of the subject after experiencing both GSIM and non-GSIM methods. The GSIM group had an overall mean of 3.88 (HI), while the non-GSIM group had a mean of 3.72 (HI). The highest mean for the GSIM group was for "I value the knowledge that I have about physics" (M = 4.26, HI), and the lowest was for "I am confident that learning physics directly corresponds to my personal preferences" (M = 3.52, HI). For the non-GSIM group, the highest mean was tied at M = 3.96 (HI) across two indicators, with the lowest at M = 3.38 (MI). All five GSIM indicators reached HI; the non-GSIM group had three HI and two MI indicators.

Table 3. Students’ mean scores on the level of interest in relation to value

Indicators	**GSIM**		**Non-GSIM**	
	Mean	**Qualitative Description**	**Mean**	**Qualitative Description**
I value the knowledge that I have about physics.	4.26	HI	3.96	HI
I really see value in what I am learning in physics.	4.04	HI	3.94	HI
It is of great importance to me to become knowledgeable in physics.	4.02	HI	3.96	HI
Studying physics has a lot to do with who I want to become as a person.	3.57	HI	3.36	MI
I am confident that learning physics aligns with my personal preferences.	3.52	HI	3.38	MI
Overall Mean	3.88	HI	3.72	HI

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Both groups saw Physics as valuable, though the GSIM group felt it more strongly. The GSIM's HI classification suggests that linking Physics to real-world stories helped students see its relevance. This aligns with Verawati and Nisrina (2025), who noted that the lack of real-world applications in Physics teaching reduces student interest and recommended contextual, interactive methods to address this issue. Tolentino (2022) also found that Gamified and Mastery-based Online Physics classes increased motivation and improved perceptions of Physics. High scores in valuing physics indicate STEM students understand its practical importance. However, lower scores on identity questions show students have not fully integrated Physics into their self-identity. The GSIM group's higher scores on these items suggest that gamification might be beginning to bridge this gap.

These findings align with Gianni and Antoniadis (2023), who found that students highly appreciate gamified methods, considering them both knowledge-enhancing and more enjoyable. Zhang et al. (2022) showed that meaningful game-based environments strengthen perceptions of value. In the Philippines, Sanchez et al. (2025) reported that gamified Physical Science teaching significantly boosted academic performance and fostered more meaningful learning among Grade 12 students. Kua et al. (2025) emphasized that deeper internalization of personal goals requires ongoing engagement with gamified experiences. Overall, the GSIM successfully created a strong sense of value for Physics, with all five indicators reaching HI. Its strength in identity-related indicators indicates that gamification helped students see Physics as both academically significant and personally meaningful. Nevertheless, full integration with long-term goals needs continuous instructional support.

Re-engagement

Table 4 displays the posttest mean scores of students' interest in Physics, focusing on their willingness to revisit the subject (Re-engagement) after experiencing the GSIM and non-GSIM formats. The data indicate that the GSIM group had an overall mean of 3.35 (MI) , while the non-GSIM group scored 3.14 (MI) . Both groups' highest mean was in "In my free time, I read and watch content on digital media" (GSIM: M = 3.65, HI; non-GSIM: M = 3.66, HI). The lowest mean for the GSIM group was in "I voluntarily engage in any physics-related activities inside or outside the school" (M = 3.07, MI), whereas for the non-GSIM group, the lowest was also in the same item (M = 2.87, MI). Overall, the GSIM group outperformed the non-GSIM group in all five indicators.

Table 4. Students' mean scores on the level of interest in relation to reengagement

Indicators	**GSIM**		**Non-GSIM**	
	Mean	**Qualitative Description**	**Mean**	**Qualitative Description**
In my free time, I read and watch content on digital media (e.g., TikTok, Facebook, Instagram, and Twitter)	3.65	HI	3.66	HI
If I am watching TV or surfing the internet, I get hooked on physics-related programs or sites	3.50	MI	3.17	MI
I often voluntarily have conversations with others about topics related to physics.	3.43	MI	3.04	MI
If I had enough time, I would work more intensely on certain aspects of physics, even if they had nothing to do with any course requirements.	3.09	MI	2.96	MI
I voluntarily engage in any physics-related activities inside or outside the school.	3.07	MI	2.87	MI
Overall Mean	3.35	MI	3.14	MI

Both groups displayed only moderate enthusiasm for voluntarily re-engaging with Physics, with the GSIM group showing a slight advantage. This suggests that, while gamification successfully ignited in-class situational interest, translating that interest into lasting, self-motivated engagement remains challenging

(Zhang et al., 2022). The highest scores in both groups were in digital media consumption, indicating students prefer familiar, entertaining platforms over traditional print or club activities. This aligns with Gianni and Antoniadis (2023), who observed students favor digital gamified methods. In the Philippine context, Malayao et al. (2026) found that leaderboard-based gamification enhanced students' personal motivation and willingness to tackle difficult Physics content. However, the MI classification indicates that true re-engagement, the hardest aspect of sustaining interest, requires continuous, varied gamified experiences over time.

These findings align with Gianni and Antoniadis (2023), who argued that gamification encourages further study but requires repeated exposure. Verawati and Nisrina (2025) noted that traditional lecture methods often lead to decreased student engagement. They recommended integrating technology, such as simulations and virtual experiments, to address this issue. Additionally, Gianni and Antoniadis (2023) found that students favor gamified digital approaches, which can help link traditional teaching techniques to students' interests. Kua et al. (2025) observed that the impact of gamification on voluntary out-of-class behaviors remains limited. Tolentino (2022) demonstrated that gamified Physics lessons in the Philippines significantly increased motivation and improved perceptions, though maintaining engagement depended on continuous reinforcement. Overall, the GSIM slightly enhanced re-engagement, with digital media being the only HI indicator. Future strategies should intentionally leverage social media and digital platforms to sustain student interest, recognizing that fostering strong, self-motivated re-engagement requires long-term, gamified teaching approaches.

Summary of Students' Level of Interest

Table 5. Students' Level of Interest in GSIM and Non-GSIM Groups

Interest	GSIM				Non-GSIM			
	Pretest		Posttest		Pretest		Posttest	
	Mean	QD	Mean	QD	Mean	QD	Mean	QD
Feelings	3.11	MI	3.38	MI	3.05	MI	3.16	MI
Value	3.77	HI	3.88	HI	3.63	HI	3.72	HI
Reengagement	3.06	MI	3.35	MI	3.09	MI	3.14	MI
Overall Mean	3.29	MI	3.52	HI	3.23	MI	3.32	MI

Table 5 presents the average scores before and after the test for students' interest in Physics, covering three areas—Feelings, Value, and Re-engagement—for both the GSIM and non-GSIM groups. Initially, both groups had similar pretest scores: the GSIM group had an overall pretest mean of 3.29 (MI), and the non-GSIM group averaged 3.23 (MI). Following the intervention, the GSIM groups' overall mean increased to 3.52 (HI), and the non-GSIM groups' overall mean increased to 3.32 (MI). In all three areas, the GSIM group scored higher after the test than the non-GSIM group. The most notable differences were in Re-engagement (3.35 vs. 3.14) and Feelings (3.38 vs. 3.16). The Value dimension was the only area to reach High Interest (HI) for both groups at both time points, while Feelings and Re-engagement remained at Moderate Interest (MI). The GSIM group showed the greatest improvements from pretest to posttest in Re-engagement (+0.29) and Feelings (+0.27), with Value improving by +0.11. The non-GSIM group had smaller gains: Feelings (+0.11), Value (+0.09), and Re-engagement (+0.05).

The pretest results confirm that the groups were comparable before the intervention. The higher overall posttest mean for the GSIM group shows that the gamified approach was more effective than traditional SIM in increasing student interest. The consistently top scores in Value suggest that STEM students already see Physics as important for their academic and career plans, regardless of the teaching method. However, the greater gains in Feelings and Re-engagement in the GSIM group indicate that gamification primarily enhances emotional engagement with Physics and encourages voluntary participation. The MI classification, which remained similar for both groups in Feelings and Re-engagement after the intervention, indicates that fostering deeper, lasting interest requires ongoing gamified teaching beyond a single session.

These findings correspond with recent research in the Philippines. Sanchez et al. (2025) found that gamified Physical Science lessons significantly improved Grade 12 students' academic performance and interest. Malayao et al. (2026) found that leaderboards in gamified settings increased motivation and engagement among students in Northern Mindanao studying Mathematical Physics. Tolentino (2022) showed that gamified Physics teaching at De La Salle University significantly raised student motivation. International studies, such as Gianni and Antoniadis (2023), concluded that gamification positively influences attitudes toward Physics, while Zhang et al. (2022) emphasized that maintaining interest requires long-term exposure to gamified environments. Additionally, Gianni and Antoniadis (2023) confirmed that students favor gamified approaches and want these methods to be a regular part of teaching.

The GSIM moderately improved student interest in Physics compared to the traditional SIM, as shown by higher posttest scores across all three areas. The intervention had the most significant impact on emotional and behavioral interest, while the cognitive aspect of Value stayed consistently high in both groups. These findings suggest that gamified SIMs can be effective tools for fostering interest, although ongoing use is recommended to foster more lasting, deep individual engagement among Grade 12 Physics students.

Analysis of Covariance (ANCOVA) on Students' Academic Achievement

Table 6 shows the ANCOVA results for students' posttest academic achievement in both the GSIM and non-GSIM groups, with the pretest as a covariate. The mean percentage scores are 62.03 (SD=12.56) for the GSIM group (n=46) and 55.18 (SD=11.81) for the non-GSIM group (n=47). The data indicate that students in the GSIM group attained higher average scores than those in the non-GSIM group, reflecting greater academic achievement in physics.

Table 6. Analysis of Covariance (ANCOVA) of the Academic Achievement for GSIM and Non-GSIM Groups

Group	**N**	**Mean**	**SD**
GSIM	46	62.03	12.56
Non-GSIM	47	55.18	11.81
TOTAL	93	58.01	12.19

Source	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**	**Partial Eta Squared**
Pretest (covariate)	2493	1	2493	20.35	<.001	0.172
Group	995	1	995	8.12	0.005	0.069
Residuals	11024	90	122			

*Significant at 0.05 level

The F-value for the two groups is 8.12, with a p-value of 0.005 ($P<0.05$), showing a highly significant difference. These results reject the null hypothesis that "there is no significant difference in students' academic achievement between those using the Gamified Strategic Intervention Material and those using the non-Gamified version." This suggests that exposure to GSIM significantly improved students' overall physics achievement compared to the non-GSIM group.

The evidence that GSIM results in significantly higher academic achievement than non-GSIM is consistent with existing research. A systematic review by Jaramillo-Mediavilla et al. (2024) shows that gamification reliably boosts motivation and academic performance, especially when integrated into instruction rather than used solely as an external reward. Almeida et al. (2019) observed that gamification interventions tend to produce small-to-moderate effects, which aligns with the differences observed between the GSIM and non-GSIM groups. In physics education, Gaurina et al. (2025) and Okariz et al. (2023) reported significant differences after controlling for prior knowledge, indicating that gamification adds value beyond students'

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existing understanding. Richter and Kickmeier-Rust (2025) suggested that gamification is most effective when embedded as a core component of instructional design, supporting the GSIM approach, where gamified elements are integrated into the learning material. Malayao et al. (2026) demonstrated that leaderboards combined with student feedback can significantly enhance achievement in mathematical physics, underscoring gamification's instructional benefits. In the Philippine context, Abuton et al. (2025), Benben and Bug-os (2022), and Maragañas and Dioso (2025) also reported notable improvements in student performance with gamified strategies. Prior knowledge is critical for learning outcomes; Coletta and Steinert (2020) emphasized that students' existing knowledge strongly predicts their future learning success. Additionally, Wong et al. (2024) found that engagement-focused interventions typically yield small-to-moderate achievement gains. These findings are consistent with the improvements observed in the GSIM group.

Significant Difference in Interest in GSIM and Non-GSIM

Table 7. Analysis of Covariance (ANCOVA) of Interest for GSIM and Non-GSIM Groups

Interest	**Group**	**Mean**	**SD**	**F-value**	**Sig.**	**Partial Eta Squared**
Feelings	GSIM	3.38	0.265	41.51	<.001	0.687
	Non-GSIM	3.16	0.172			
Value	GSIM	3.88	0.322	98.494	<.001	0.930
	Non-GSIM	3.72	0.320			
Reengagement	GSIM	3.35	0.257	50.30	<.001	0.731
	Non-GSIM	3.14	0.311			

*Significant at 0.05 level

Table 7 displays the ANCOVA results comparing posttest interest scores between students exposed to the GSIM and those not exposed, across the three dimensions of Feelings, Value, and Re-engagement.

The ANCOVA findings show significant differences between the two groups across all three interest dimensions. For Feelings, the GSIM group ($M = 3.38$, $SD = 0.265$) outperformed the non-GSIM group ($M = 3.16$, $SD = 0.172$), with $F (1) = 41.51$, $p < .001$, and a large effect size ($\eta p^2 = 0.687$). In terms of Value, the GSIM group ($M = 3.88$, $SD = 0.322$) scored notably higher than the non-GSIM group ($M = 3.72$, $SD = 0.320$), with $F(1) = 98.494$, $p < .001$, and a very large effect size ($\eta p^2 = 0.930$). For Re-engagement, the GSIM group ($M = 3.35$, $SD = 0.257$) also exceeded the non-GSIM group ($M = 3.14$, $SD = 0.311$), with $F (1) = 50.30$, $p < .001$, and a large effect size ($\eta p^2 = 0.731$). All p-values are below 0.05, confirming that the differences are statistically significant. The highest F-value was in Value, while the largest effect size was also in Value ($\eta p^2 = 0.930$).

The significant differences across all three dimensions confirm that the GSIM was markedly more effective than the traditional SIM in boosting student interest in Physics. The large-to-very-large effect sizes indicate that the gamified approach led to not only statistically significant improvements but also meaningful practical gains. The very large effect size for Value ($\eta p^2 = 0.930$) suggests that elements such as engaging narratives and real-world applications greatly enhanced students' perception of Physics' relevance. This aligns with Sanchez et al. (2025), who found that gamified teaching in Philippine Grade 12 Physical Science increased student interest and created more meaningful learning experiences. Additionally, the large effect size for Feelings ($\eta p^2 = 0.687$) and Re-engagement ($\eta p^2 = 0.731$) shows that the GSIM's interactive challenges and instant feedback made Physics learning more emotionally engaging and encouraged voluntary participation, consistent with findings by Gianni and Antoniadis (2023) and Malayao et al. (2026).

Recent empirical evidence strongly supports these findings. Verawati and Nisrina (2025) emphasized that interactive, inquiry-based pedagogies and contextualized curricula are vital for revitalizing Physics education. Zhang et al. (2022) showed that game-based environments effectively ignite and sustain situational interest. Kua et al. (2025) observed large effects on learners' attention and satisfaction following gamified Physics lessons. Tolentino (2022) reported a significant boost in student motivation through gamified Physics instruction at De La Salle University. Overall, the ANCOVA results clearly indicate that GSIM significantly outperformed non-GSIM in improving all three student interest dimensions—Feelings, Value, and Re-engagement—with large-to-very-large effect sizes. These findings confirm that the Gamified approach within the Strategic Intervention Material is a highly effective pedagogical tool for increasing student interest in Grade 12 Physics.

CONCLUSION

The results show that the Gamified Strategic Intervention Material (GSIM) was significantly more effective than the traditional non-GSIM method in improving both academic results and student interest among Grade 12 STEM Physics students. The GSIM group experienced notable gains across all three interest categories: Feelings, Value, and Re-engagement. However, while the overall interest of the GSIM group reached High Interest, many students still scored below the targeted achievement levels. These results indicate that while the gamified approach made Physics more engaging and emotionally appealing, a single intervention alone was not enough to close learning gaps or foster sustained interest. To achieve better outcomes, schools should consider consistently integrating gamified materials across multiple grading periods, using elements such as weekly leaderboards (displaying top students by accumulated points), custom usernames, progressive challenges (unlocking higher levels upon completion), and a fail-safe environment (unlimited retries with no penalty).

Furthermore, equipping teachers with the skills and resources needed to design and implement effective gamified lessons is essential. Schools can provide training programs and learning action cell sessions that teach the basics of gamification design and how to align game elements with specific learning goals. Combining well-designed gamified materials with teacher development efforts can help ensure students have a more consistent and high-quality gamified learning experience. Additionally, since students are most willing to re-engage with Physics through digital media platforms, future initiatives should strategically leverage social media and accessible digital tools to sustain interest beyond the classroom. Integrating gamification with motivation-enhancing strategies and practical, technology-driven learning methods will improve students' academic success and foster a more active, intentional, and self-directed approach to studying Physics.

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