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Research Article

Validation of the Developed Innovative Supplemental Materials (ISMs) on the Least-learned Competencies in Grade 8 Physics

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ABSTRACT

The main objective of this study is to validate the developed innovative supplemental materials (ISMs) as instructional support in mastering the least-learned competencies (LLC) in eighth-grade physics. The study underwent planning, development, and validation phases. Planning involved identifying the LLC and creating five ISMs. In the development stage, ISMs were built using Microsoft PowerPoint and iSpring Suite 11, incorporating PhET simulations and interactive videos accessible online and offline. Validation involved three experts and 60 students from three schools in the Tago II District. Statistical tools like weighted mean and ANOVA were used for data analysis.

The findings revealed that experts rated the ISMs "very satisfactory" in content, instructional, technical quality, and supplementary evaluation. Posttest results of student-users showed positive mean gain scores greater than 7, indicating significant enhancement in learning outcomes. There was no significant difference in posttest results across the three schools ($\rho = 0.584$), underscoring the effectiveness of ISMs in enhancing LLC mastery in physics. Despite challenges such as intermittent connections, freezing slides, inoperative subtitles, sound synchronization issues, and malfunctioning control buttons, enhancements were made to address these problems. The study concludes that ISMs significantly improved students' mastery of LLC and recommends their use in teaching physics to make learning more effective and interactive as part of innovative pedagogical practices in education.

Keywords: *Innovative supplemental materials, PhET simulation, Least-learned competency, Physics, Validation, Force and motion*

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Introduction

Many students find physics challenging and boring, leading to poor performance. This lack of interest and difficulty in relating classroom content to real life contributes to low academic achievement (Bouchée et al., 2022). According to Fortus and Vedder-Weiss (2014), as cited in Zhang et al. (2024), the difficulty in understanding and interpreting science-related concepts often leads to negative emotions, unpleasant experiences, and a reduced motivation to study science. The Philippines scored low in science in the 2018 PISA report (Rosal et al., 2022). Additionally, schools often lack instructional resources to improve teaching quality (Sanchez et al., 2019; Montero & Geducos, 2022). In response, educators are developing innovative materials, like interactive simulations (e.g., PhET), gamified materials, and engaging videos, to make learning more interactive and exciting for students. Similarly, Agyei and Agyei (2021) mentioned that physics misconceptions echo the need for innovative, relevant, and suitable teaching methods and technology-based (Gadille et al., 2021) interventions to be adopted not just to clear students' misconceptions about physics but also to provide authentic avenues for enhanced learning of the subject matter.

The PhET Interactive Simulation, created by Carl Wieman and the University of Colorado Boulder, aims to make physics engaging and accessible. According to McKagan (n.d.) PhET is a suite of research-based interactive computer simulations for teaching and learning physics, chemistry, math, and other sciences. Studies by Banda and Nzabahimana (2021) revealed that integrating PhET simulations significantly enhances students' conceptual understanding of physics by utilizing inquiry-based activities, virtual labs, problem-based learning, and scaffolded approaches. The simulations leverage students' pre-existing knowledge, making them highly valued in teaching. Further research by Banda and Nzabahimana (2022), and Gani et al. (2020) highlights PhET simulations' positive impact on students' motivation and academic achievement. Zainuddin et al. (2020) found that when students are engaged and motivated, they show positive behavior, develop better critical thinking skills, and have more meaningful learning experiences. A lack of engagement in learning can prevent students from achieving good results because staying engaged is essential for them to remember what they learn at any education level. Additionally, Amsalu (2021) found that PhET simulations help correct misconceptions and enrich understanding, specifically regarding electricity topics for eighth-grade students.

While PhET simulations have shown positive effects on students' understanding, motivation, and instructional quality, there's a lack of research on their effectiveness within specific physics learning contexts and the best strategies for their integration to maximize impact on student understanding (Banda & Nzabahimana, 2022; Amsalu, 2021). Existing studies have focused more on biology, chemistry, computer studies, and mathematics, leaving a gap in research on simulation-based learning's impact on academic achievement in physics. Further studies across various schools are needed to assess the effectiveness of PhET simulations in physics education. Integrating PhET simulations offers opportunities to meet the needs of 21st-century learners and enhance conceptual understanding, but more research is required to determine the optimal methods for their integration (Banda & Nzabahimana, 2021). Traditional teaching methods often fail to engage students fully, whereas innovative materials like interactive simulations, online resources, and game-based learning could enhance the learning experience but need further exploration.

Traditionally, physics has been taught using lecture-based methods and textbook learning, which often fail to fully engage students or facilitate a deep understanding of complex concepts (Zainuddin et al. 2020; Marcinauskas et al., 2024). The attainment of high levels of student engagement and motivation is of great importance, as research has demonstrated its positive impact on academic achievement (Zourmpakis et al.,

2023). Traditional lecture-based and textbook methods in physics often don't engage students or help them deeply understand complex concepts. This highlights the need for more interactive and innovative teaching approaches to improve learning outcomes. The lack of models or representations of invisible concepts and the lack of facilities (Marces & Caballes, 2019; Sanchez et al., 2019; Montero & Geducos, 2022) are also some of the reasons why student shardly understand science concepts, especially in physics, which is considered an abstract subject due to the lack of an informal meaning to connect it to ordinary real-life experiences (Bouchée et al., 2022). This causes students to apply concepts incorrectly, leading to a lack of understanding. Additionally, it can result in frustration and a lack of confidence in their abilities, making it harder for them to engage with the subject in the future (Zhang et al., 2024). This gap not only hinders the adoption of innovative teaching methods but also maintains a cycle of outdated educational practices. Thus, these issues show the need for consistent support and investment to help all educators (Zainuddin et al. 2020) use innovation and technology-driven materials effectively in their classrooms. By leveraging technology-driven materials, educators can enhance students'overall learning experience and performance, leading to better academic outcomes (Zainuddin et al. 2020)

The study aims to validate innovative supplementary materials (ISMs) that integrate PhET simulations to improve students' least-learned competencies. Developingthese innovative materials is crucial for inclusive, effective, holistic education, empowering students, supporting teachers, and ensuring no learner is left behind. This aligns with the Philippine K-12 Curriculum's "No Child Left Behind" policy (UNESCO, n.d.), therefore, this study endeavored to validate and use the innovative supplemental materials as a strategy that would enhance students' conceptual understanding and improve their least mastered competencies in science 8 - Physics. Specially, this study sought to answer the following objectives:

1 What are the least-learned competencies of the eighth-grade respondents in physics?
2 What is the expert's assessment rating of the ISMs content, instructional, technical quality, and supplementary evaluation?
3 What are the students' and teachers' assessment ratings of the ISMs visual quality, learning environment, and digital interface?
4 What is the mean gain score of the pretest and posttest of the students in the three different schools using the innovative supplementary materials?
5 What is the significant difference in the posttest results of the students in the three different schools using the innovative supplementary materials?
6 What challenges are encountered by the respondents utilizing the innovative supplementary materials (ISMs)?

Null Hypothesis

H_O: There is no significant difference between the posttest results of the students in the three different schools using the innovative supplementary materials (ISMs).

Scope and Limitation

The present study aimed to validate the developed innovative supplemental material designed to enhance students' least-learned competency by integrating the PhET interactive simulation. The prime subjects of this study were the Grade 8 students from three different schools in the Tago II District of Division Surigao del Sur, namely Gamut National High School, Alba Integrated School, and Badong National High School. The inclusion criteria for research respondents in this study were students who scored below 75% on the diagnostic test in Science 8, as identified through item analysis by subject teachers.

The study was limited to the least learned competencies covered mostly in the First Quarter—physics (Force and Motion)—as determined through diagnostic assessment of the School Year 2023-2024. The study's findings were focused only on the results

gathered from the subjects of the study where the innovative supplementary materials (ISMs) were conducted; thus, the data would only be true to the group of students and the school where it was performed.

Methods *Research Design*

This study utilized a developmental research design. The ADDIE model was incorporated into the material development process, identifying and analysing the competencies of eight-grade students across three schools. These competencies formed the basis for creating innovative supplemental materials. The study quantitatively examined the mean gain scores from pretest and posttest results using these materials in learning physics and explored significant differences in posttest results among the three schools.

The study involved 60 eighth-grade students (31 males and 29 females) from three schools in Tago II District namely: Gamut National High School, Alba Integrated School, and Badong National High School, during the School Year 2023-2024. Using purposive sampling, the study selected students who scored below 75% on a diagnostic Science test, which was determined through the item analysis conducted by the subject teachers. This method ensured participants shared characteristics relevant to the objectives of the study.

Development of Innovative Supplemental Materials (ISMs)

Table 1 shows the blueprint of the developed innovative supplemental materials (ISMs) based on the least-learned competencies of the first quarter MELCs for the School Year 2023-2024.

Respondents of the Study

Table 1. Blueprint of the Innovative Supplemental Materials in Science 8 - Physics

Competencies	Topics	ISM No.	Title	PhET Simulation
Investigate the relationship between the amount of force applied and the mass of the object to the amount of change in the object's motion.	Second Law of Motion	1	Unseen Forces: Acceleration	Forces-and-motion-basics
Infer that when a body exerts a force on another, an equal amount of force is exerted back on it.	Third Law of Motion	2	Unseen Forces: Interaction	Forces-and-motion-basics
Identify and explain the factors that affect potential and kinetic energy.	Kinetic and Potential Energy	3	Ball of Energies	Energy-skate-park
Infer the relationship between current and voltage.	Ohms Law	4	Ohm, my Proportions!	Ohms-law
Explain the advantages and disadvantages of series and parallel connections in homes.	Series and Parallel Circuit	5	Bombastic Electricity	Circuit-construction-kit-dc

As displayed in Table 1, there were five innovative supplemental materials developed based on the identified least-learned competencies. These materials included five PhET interactive simulations: (1) Unseen Forces: Acceleration, (2) Unseen Forces: Interaction, (3) Ball of Energies, (4) Ohm my Proportions, and (5) Bombastic Electricity. The ADDIE model was used as the framework, involving planning, development, and validation phases.

Phase 1. Planning

The first procedure was item analysis to determine the least learned competencies (LLC). The consolidated mean percentage score (MPS) revealed that the least mastered competencies were observed among eighth-

grade students in physics during the diagnostic assessment in science. The identified competencies serve as the foundation for creating objectives, which, in turn, guide the development of the initial draft of the ISM design.

Phase 2. Development

Innovative supplemental materials were developed with Microsoft PowerPoint, incorporating interactive features to create engaging and user-friendly content. These materials included clear objectives, detailed instructions, and activities tailored to specific competencies. Gamified elements like puzzles, quizzes, and PhET simulations were integrated to make learning enjoyable and interactive. PhET simulations, developed by Colorado University PhET (n.d.), allowed students to explore real-life scenarios in a virtual environment. The materials also featured storytelling elements, animations, and sound to enhance the learning experience.

To further enhance functionality, iSpring Suite 11 was used, integrating seamlessly with PowerPoint to create interactive e-learning content. This suite empowers course developers and educators to design interactive e-learning content, including courses, quizzes, and video tutorials, and its impact lies in facilitating the creation of engaging and effective educational materials (Alexandria, 2022).

For accessibility, Hostinger was used for web hosting, and Filezilla for file transfer. According to Shojib (2023), Hostinger is a web hosting service provider that enables individuals, small businesses, and large enterprises to make their websites accessible on the Internet. Hence, to store the data of the material, the researcher used Filezilla, an FTP client, which stands for File Transfer Protocol; it is a network communication protocol used to transfer digital files between a server and a client on a computer network. Finally, the material was stored in website data, ensuring that users could access it anytime and anywhere. Offline innovative supplemental materials were also created to manage challenges accessing the online ISMs. The materials underwent pilot testing and initial assessments by experts before being implemented in the three schools under study.

Validation of the Innovative Supplemental Materials

The developed innovative supplemental materials undergone validation of the three (3) experienced science validators, who are either science master teachers or hold units in M.S. or M.S.T. and have over five years of experience, were selected to evaluate the innovative supplemental materials. The evaluation tool was based on the DepEd Evaluation Rating Sheet for Non-Print Materials retrieved from DM No. 441 s. 2019 Guidelines and Process for LRMDS Assessment and Evaluation of Locally Developed and Procured Material, focusing on content quality, instructional quality, and technical quality. Validators used a 4-point Likert scale to rate the materials, with their feedback serving to improve the initial and final drafts. This process ensured the materials were ready for implementation.

Research Instrument

The researcher adopted questions from the validated learning activity sheets from the region for the pretest and posttest to be used by the respondents. It consists of several questions that determine the student's achievement in terms of science processing skills which was anchored to the table of specification. In addition, the researcher also adopted a checklist questionnaire from Alhadlaq's study (2023), which aims to describe the students' affective domain on the use of ISM. Similarly, the researcher has conducted an interview or focus group discussion with the respondents to allow students to express more about their feelings and difficulties encountered using the innovative supplemental materials (ISMs).

Data Collection

The study began with formal approval from the Office of the Superintendent of Surigao del Sur, followed by an orientation for the respondents. The researcher identified least-mastered competencies through interviews with subject teachers and analyzed

these using the consolidated Mean Percentage Score (MPS) from diagnostic assessments.

The final implementation of the ISMs took place during a summer class over five meetings, each lasting two hours. Students completed a pretest, engaged with the ISMs, and then took a posttest to measure learning gains. Data from pretest and posttest results were analyzed to assess the ISMs effectiveness. A checklist questionnaire and focus group discussions were conducted to gather students' perceptions and identify any difficulties. The final stage involved modifying and producing the ISMs based on these findings, confirming their effectiveness in teaching physics concepts.

Data Analysis

The study utilized both descriptive and inferential statistics to analyze the assessment results. Descriptive statistics, specifically the mean, were used to determine the assessment ratings and the pretest and posttest results. The mean gain score was calculated to measure the difference between students' pretest and posttest scores. To identify significant differences in the posttest results among students from the three schools, Analysis of Variance (ANOVA) was employed. This statistical method helped determine whether the observed differences in posttest scores were statistically significant, providing insights into the effectiveness of the innovative supplemental materials across different educational settings. Additionally, interviews from focus group discussions were analyzed thematically to identify common themes and insights from the students' and teachers' experiences.

Results and Discussions

The Least-learned Competencies of Grade 8 Students in Science

Table 2 shows the consolidated least-learned competencies of the eighth-grade students in science which were obtained mostly from the first grading MELCs of the School Year 2023 -2024.

Table 2. Least-learned competencies of grade 8 students in science

Grading Period	Competencies	Average MPS	Interpretation
First	Investigate the relationship between the amount of force applied and the mass of the object to the amount of change in the object's motion.	39.11%	Below Mastery
First	Infer that when a body exerts a force on another, an equal amount of force is exerted back on it.	32.50%	Below Mastery
First	Identify and explain the factors that affect potential and kinetic energy.	42.17%	Below Mastery
First	Infer the relationship between current and voltage.	43.75%	Below Mastery
First	Explain the advantages and disadvantages of series and parallel connections in homes.	37.65%	Below Mastery

As depicted in Table 2, the results indicate that students are struggling with key physics concepts, as all competencies assessed in the first grading period fall below mastery level. The average Mean Percentage Scores (MPS) for the competencies range from 32.50% to 43.75%, highlighting significant

Experts Assessment of the Developed Innovative Supplemental Materials (ISMs)

The validation of Innovative Supplemental Materials (ISMs) involves a thorough evaluation based on content quality, gaps in understanding. This struggle is attributed to the abstract nature of physics and the lack of real-world connections, the absence of models, representations, and facilities for practical application further hampers understanding (Bouchée et al., 2022). quality, instructional quality, and supplementary evaluation, using a 4-

point Likert scale. This comprehensive approach highlights strengths and areas for improvement, ensuring the ISMs meet the needs of their intended audience and enhance learning outcomes. By rigorously assessing these factors, the validation process guarantees the delivery of high-quality educational resources.

Table 3. Experts Assessment of Five ISMs in terms of Content Quality

CONTENT QUALITY	Mean	Interpretation
Content is consistent with topics/skills found in the DepED Learning Competencies for the subject and grade/year level it was intended.	4.00	Very Satisfactory
Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	4.00	Very Satisfactory
Content is accurate.	4.00	Very Satisfactory
Content is up-to-date.	4.00	Very Satisfactory
Content is free from cultural, gender, racial, or ethnic bias.	4.00	Very Satisfactory
Content stimulates and promotes critical thinking.	3.67	Very Satisfactory
Content is relevant to real-life situations.	3.67	Very Satisfactory
Content promotes positive values that support formative growth.	3.53	Very Satisfactory
Language (including vocabulary) is appropriate to the target user level.	3.47	Very Satisfactory
Content is logically developed and organized.	3.33	Very Satisfactory
Overall Mean	**3.77**	**Very Satisfactory**

Table 3 presents the content quality of the developed ISMs received high ratings from experts, with a mean score of 4.00, indicating "Very Satisfactory." The overall mean score of 3.77 on a 4-point Likert scale reflects a high level of satisfaction. Given the high scores, these ISMs could serve as a model for future educational materials, influencing curriculum development and setting educational standards ensuring content accuracy, credibility, and engagement. Accurate and relatable content enhances students' understanding and motivation (Zainuddin et al., 2020). However, the logical organization scored slightly lower at 3.33, suggesting areas for improvement. These findings suggest that while the ISMs are generally well-regarded, enhancements have been made to address the identified organizational issues, ensuring the materials are more logical and effective in facilitating learning.

Table 4. Experts Assessment of Five ISMs in terms of Instructional Quality

INSTRUCTIONAL QUALITY	Mean	Interpretation
Purpose of the material is well defined.	4.00	Very Satisfactory
Material achieves its defined purpose.	4.00	Very Satisfactory
Learning objectives are clearly stated and measurable.	4.00	Very Satisfactory
Level of difficulty is appropriate for the intended target user.	4.00	Very Satisfactory
Material is enjoyable, stimulating, challenging, and engaging.	4.00	Very Satisfactory
Material effectively stimulates creativity of target user.	3.60	Very Satisfactory
Graphics / colors / sounds are used for appropriate instructional reasons.	3.33	Very Satisfactory
Instruction is integrated with target user's previous experience.	3.33	Very Satisfactory
Target user can control the rate and sequence of presentation and review.	3.13	Satisfactory
Feedback on target user's responses is effectively employed.	3.00	Satisfactory
Overall Mean	**3.64**	**Very Satisfactory**

As gleaned in Table 4, The instructional quality of the five developed Instructional Support Materials (ISMs) received high ratings from experts, with an overall mean score of 3.64, indicating "Very Satisfactory." These high ratings suggest that the ISMs can be effectively integrated into educational settings to enhance teaching and learning processes. However, areas for improvement were identified, such as better feedback mechanisms and more user control over the rate and sequence of presentation. Enhancements have been made to provide specific feedback and options to customize the learning experience, making the ISMs more effective and user-friendly. Likewise, feedback helps learners to stay focused on their goals. In some previous research, there is an understanding that positive feedback and encouraging messages can lead to positive experiences (Sanchez et al., 2019). Enhancements aimed to make the ISMs more flexible and aligned with user needs and expectations, ultimately contributing to better educational outcomes.

Table 5. Experts Assessment of Five ISMs in terms of Technical Quality

TECHNICAL QUALITY	Mean	Interpretation
Visual presentations (non-text) are clear and easy to interpret.	4.00	Very Satisfactory
Visuals sustain interest and do not distract user's attention.	4.00	Very Satisfactory
The user support materials (if any) are effective.	4.00	Very Satisfactory
The design allows the target user to navigate freely through the material.	4.00	Very Satisfactory
The material can easily and independently be used.	4.00	Very Satisfactory
The material will run using minimum system requirements.	4.00	Very Satisfactory
Visuals provide accurate representation of the concept discussed.	3.93	Very Satisfactory
Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.	3.67	Very Satisfactory
Audio enhances understanding of the concept.	3.60	Very Satisfactory
Music and sound effects are appropriate and effective for instructional purposes.	3.47	Very Satisfactory
Speech and narration (correct pacing, intonation, and pronunciation) is clear and can be easily understood.	3.33	Very Satisfactory
The program is free from technical problems.	3.27	Satisfactory
There is complete synchronization of audio with the visuals, if any.	3.00	Satisfactory
Overall Mean	**3.83**	**Very Satisfactory**

Table 5 presents the experts' assessment of the five ISMs in terms of technical quality yielded an overall mean score of 3.83, indicating "Very Satisfactory." Key strengths included clear and engaging visual presentations, effective user support materials, and ease of navigation and use, which enhance students' learning experiences. However, areas for improvement were identified in audio synchronization and technical reliability, with scores of 3.00 and 3.27, respectively. Recognizing these issues, enhancements have been made to create a more seamless and user-friendly experience, thereby increasing the effectiveness of the ISMs in facilitating learning. Hence, this underscores the importance of continuous evaluation and refinement in developing educational materials, ultimately contributing to more effective and engaging learning experiences.

Table 6. Experts Supplementary Evaluation of Five ISMs

Other Findings	Mean	Interpretation
Conceptual errors.	4.00	Not Present
Factual errors.	4.00	Not Present
Grammatical and / or typographical errors.	4.00	Not Present
Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	4.00	Not Present
Overall Mean	**4.00**	**Very Satisfactory**

Table 6 illustrates the overall mean score of 4.00, indicating a "Very Satisfactory" rating, which affirms the quality and accuracy of the instructional materials (ISMs). Experts' supplementary evaluation revealed that the ISMs were free from conceptual, factual, grammatical, typographical, and other errors, each category receiving a perfect mean score of 4.00, interpreted as "Not Present." This underscores the thorough development and review process, ensuring the ISMs were error-free and reliable for educational use.

The material is rated based on several criteria, each criterion is assessed on a scale, typically ranging from "4-Not Present", "3-Present but very minor & must be fixed", "2 – Present & requires major redevelopment" to "1-Requires Major Redevelopment," allowing for a nuanced understanding of the material's strengths and weaknesses.

Conceptual errors are scrutinized to ensure the clarity and soundness of the underlying ideas, while factual errors are checked to maintain the integrity of the information presented. Grammatical and typographical errors are also evaluated, as they can affect the readability and professionalism of the material.

Student-user assessment on the utilization of the ISM

Student-user assessment on the utilization of the ISM. The 5-point Likert scale questionnaire survey used was adapted from the study of Alhadlaq (2023) with three main categories: visual quality, learning

Other errors, such as those in visuals or calculations, are identified to ensure comprehensive accuracy and confirm that all criteria meet the standard rating after necessary enhancements have been made before the final ISMs are rated. environment, and digital interface. This survey provides valuable insights into how students perceive and interact with the ISMs, highlighting areas of strength and potential improvement. The feedback gathered is crucial for refining the materials to better meet student needs and enhance their learning experience.

Table 7. Student-user Assessment of ISMs in terms of Visual Quality

Visual Quality	Weighted Mean	Interpretation
The innovative supplemental materials (ISM) are eye-catching.	5.00	Strongly Agree
The overall design and visual elements drive motivation and engagement.	4.95	Strongly Agree
The attached images are of sufficient size for viewing.	4.93	Strongly Agree
The design layout is appropriate to the intended audience.	4.90	Strongly Agree
The colors are vibrant but are not distracting.	4.88	Strongly Agree
The pages of this lesson have a clean and straightforward appearance.	4.87	Strongly Agree
The colors used are appealing and consistent.	4.85	Strongly Agree
Each page is filled with enough words, which makes it engaging.	4.82	Strongly Agree
The layout and positioning of the text and images are organized.	4.80	Strongly Agree
Overall Mean	**4.89**	**Strongly Agree**

Table 7 presents the student-user assessment of the ISMs in terms of visual quality yielded an overall mean score of 4.89, indicating "Strongly Agree." Respondents found the ISMs eye-catching and engaging, with appropriate design elements, vibrant colors, and a clean layout, enhancing their motivation and interest in learning. However, slightly lower scores were given for the organization of text and images, highlighting areas for improvement in layout consistency and navigation. These findings led to enhancements in layout organization and content balance, ultimately improving the user experience and facilitating better learning outcomes. An organized and visually appealing learning environment increases student commitment, interest, and academic performance.

Table 8. Student-user Assessment of ISMs in terms of Learning Environment

Learning Environment	Weighted Mean	Interpretation
The language used is straightforward and accurate which helped me understand the lesson.	4.95	Strongly Agree
The activities in the ISM were clear and easy to follow.	4.92	Strongly Agree
The concepts applied real-life examples which I can relate to.	4.90	Strongly Agree
The ISM is presented in good order and I enjoyed the lessons so much that I would like to know more about the topics.	4.90	Strongly Agree
The exercises in this lesson were engaging.	4.90	Strongly Agree
The lessons were easy to understand and suitable for my level.	4.88	Strongly Agree
The ISM helped me better understand the concepts covered in the lecture.	4.88	Strongly Agree
The way the information is arranged on the pages helped keep me focused.	4.85	Strongly Agree
The ISM provided new learning opportunities I would otherwise not have experienced in traditional classes.	4.85	Strongly Agree
The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the lesson.	4.83	Strongly Agree
Overall Mean	4.89	Strongly Agree

Table 8 depicts the student-user assessment of the ISMs yielded an overall mean score of 4.89, indicating strong agreement with their effectiveness. Key aspects such as straightforward and accurate language, clear activities, relatable real-life examples, and engaging exercises received high ratings, suggesting that the ISMs are well-organized, level-appropriate, and engaging (Zourmpakis et al., 2023).

The highest-rated criterion was the clarity and accuracy of the language used, which significantly aided student understanding. Although the variety of materials and new learning opportunities received slightly lower ratings, these areas were addressed in the final ISM enhancements making the learning environment more engaging.

Table 9. Student-user Assessment of ISMs in terms of Digital Interface

Digital Interface	Weighted Mean	Interpretation
The material is user-friendly and does not require advanced ICT skills for operation.	4.98	Strongly Agree
The overall use of the ISM is easy, engaging, and fun.	4.98	Strongly Agree

Digital Interface	Weighted Mean	Interpretation
The ISM allows me to access the material at any time and place.	4.93	Strongly Agree
The screen displays, including text, fonts, and size, are readable.	4.90	Strongly Agree
The material is convenient for me because it can be accessed on any device.	4.88	Strongly Agree
The pages of the ISM transition smoothly from one to the next.	4.87	Strongly Agree
The controls, buttons, and objects for navigation are straightforward and user-friendly.	4.83	Strongly Agree
The sound and audio effects are clear and do not cause any disturbance to my ears.	4.73	Strongly Agree
The ISM operates without lagging.	4.70	Strongly Agree
The subtitles are synchronized with the audio.	4.63	Strongly Agree
Overall Mean	**4.85**	**Strongly Agree**

As displayed in Table 9, the student-user assessment of the Innovative Supplementary Materials (ISMs) reveals a highly positive reception of the digital interface, with an overall mean rating of 4.85, indicating strong agreement on the effectiveness of the digital features. The highest-rated aspects include the user-friendly nature and engaging use of the materials, both scoring 4.98, highlighting their accessibility and ease of use across various devices. These features minimize technical barriers and enhance student motivation and engagement, leading to better learning highlight the average improvement or progress outcomes. Although slightly lower, the ratings for sound clarity, lag-free operation, and synchronized subtitles still reflect strong user satisfaction. These aspects were addressed during the final enhancements of the ISMs, further improving the user experience. Overall, the ISMs are perceived as attractive, visually appealing, and user-friendly, significantly contributing to student performance and understanding.This underscores the importance of designing digital learning materials that are both accessible and engaging to maximize their educational effectiveness. made by students between two points of measurement, such as before and after the instructional intervention (Layson, 2022). These results provide valuable insights into the impact of ISMs on student learning outcomes, demonstrating their potential to enhance educational effectiveness.

Mean Gain Score of the Pretest and Post-test of the Students

The following discussions present the results of the pretest and posttest scores after implementing the Innovative Supplemental Materials (ISMs), which were used to evaluate their effectiveness. The mean gain scores

Table 10. Mean Gain Score of Students' Achievement in Pretest and Posttest

School	Average		Mean Gained Score
	Pre-Test	Post-test	
School 1	12.15	20.69	8.54
School 2	14.50	21.60	7.10
School 3	13.71	20.93	7.22

The analysis of Table 10 reveals a significant increase in post-test scores among students from three schools, with scores showing substantial improvement compared to their pre-test mean scores. The mean gain scores exceeding 7 indicate that the Innovative Supplemental Materials (ISMs) effectively enhanced students' conceptual understanding of previously challenging competencies. This finding aligns with Vittorini &

Galassi (2021), who noted that effective educational tools boost learning performance. Additionally,

Torres et al. (2021) & Zourmpakis et al. (2023), emphasized that such tools can ignite student motivation and engagement, helping them stay focused and achieve their learning goals. Wang & Na (2023) further support this by highlighting the role of technology-based resources in inspiring and involving learners. Overall, the use of ISMs has proven to be a valuable strategy in improving educational outcomes by leveraging technology to make learning more engaging and effective.

Significant Difference of Posttest Results of the Students

Table 11 Significant Difference of Posttest Results after utilizing the ISMs

	ρ-value	Decision	Conclusion
Posttest	0.584	Fail to Reject Ho	There is no significant difference

**a=0.05*

The statistical analysis in Table 11 indicates no significant difference in post-test results across the three schools, suggesting that the Innovative Supplemental Materials (ISMs) had a consistent impact on student performance regardless of the school type. This uniform effectiveness implies that ISMs can be broadly implemented across various educational settings with similar positive outcomes. According to Gutierrez et al. (2021),

Challenges encountered by the students utilizing the ISMs

The following discussions show the challenges encountered by the respondents when utilizing the innovative supplemental

Buffering impedes engagement. Students mostly encountered low connectivity that hampered their engagement when utilizing the online learning materials. Slow internet speeds can lead to interruptions (Hampton et al., 2020; Layson, 2022) causing the page to pause and sometimes cause distortions while waiting for more data to load (Hampton et al., 2020). This issue was addressed in the final ISMs, which the improvement in students' post-test scores, compared to their more dispersed pre-test scores, highlights the effectiveness of ISMs in enhancing knowledge and understanding. The significant increase in mean post-test scores demonstrates that students were able to answer more questions correctly after using the ISMs, confirming their role in improving learning outcomes. materials. The interviews and reflection notes gathered during the focus group discussions were transcribed, analyzed, and grouped themes. now include offline access options to overcome connectivity problems. Below are some of the students' interviews and reflection notes describing the challenges encountered utilizing the innovative supplemental materials.

Student A – *Ganahan ako kay madayaw ang mga duwa taraw pero usahay mag lage mag siya mo pikit.* [I enjoy using it due to the engaging activities, but there are occasional pauses.]

Student B – *….naman matinga ako kay kapila ko na gipislit di gihapon mo next ga lag na baya.* […I sometimes find myself wondering because no matter how many times I click the next button, it fails to advance due to what seems like lag.]

Student C – *Dayaw ang design tapos yauy duwa pero usahay siya mag loading kay lage damo ang yakaconnect sa wifi (router) naman maghuwaton pa adisir ma next ang page.* [The design is nice and there's a game but sometimes it's loading because many students were connected to the wifi,(router) so it takes time to load the next page.]

Student feedback highlighted these challenges, with comments about engaging activities being disrupted by pauses, lagging navigation, and slow loading times due to

multiple users on the same network. The implication is clear: ensuring reliable access to educational materials, whether online or offline, is crucial for maintaining student engagement and effective learning. By incorporating offline access, the ISMs can now provide a more consistent and uninterrupted learning experience, enhancing overall educational outcomes.

Freezing slide. A slide in a presentation becomes unresponsive or stuck, preventing any further interaction or progression. Frequent interruptions can break the continuity of the presentation, making it difficult for the learners to follow along and stay engaged.

Student D – *....pagpislit nako kaina mipikit ang iya slide, ... usahay makalanganay..* [...earlier when I clicked it, the slide freezes... sometimes it causes delay...]

Student E – *....may ako gihanap na slide balikan ko garo pag click ko dugayi mo view tapos taod-taod min pikit na...* [...I was finding some slide that I wanted to view again then when I clicked it, the slide takes a longer time to view then later it froze...]

Inoperative Subtitle. Subtitles can aid in comprehension by providing a written form of the spoken content. Without them, learners may struggle to grasp complex information. Subtitles help reduce cognitive load by allowing learners to read along with the audio (Abdulrahaman et al., 2020; Harrison, 2020; Noetel et al., 2021).

Student F – *....ang iban videos mugana ang subtilte pero yauy iban sab dili..* [...other videos have working subtitles but others are not functional...]

Student G – *....kung may subtitle dayaw pero ang iban [videos] lamang wara...* [... it's nice if there is a subtitle available but other [videos] doesn't have...]

Control Buttons. Non-functional control buttons can interrupt the smooth flow of the presentation, causing delays and breaking the continuity of the learning experience.

Student H – *....gidouble ko na pagclick wara siya mi next..* [...I double click it but it's not viewing the next slide...]

Student I – *....paghinay da an signal dili mugana ang iban [buttons]...* [...when the internet connections seem weak, other [buttons] will not work...]

Sound Synchronization. Misaligned audio and visuals can lead to confusion and misunderstandings, reducing overall comprehension of the material (Schulz & Iskru, 2021). The inconsistency can be distracting, causing learners to lose focus and miss important points.

Student J – *...naman sab usahay gadouble ang iya sounds kaina pagbalik nako sa previous slide..* [...that is why sometimes the sound doubles just like earlier when I view the previous slide...]

Table 12, summarizes the transcribed interviews with the students about the challenges encountered when utilizing the ISMs.

Table 12. Summary of the transcribed interviews and its interpretation about the challenges encountered utilizing the developed ISMs

Interview	Interpretation
Engaging activities, but occasionally impeded by pauses.	• Students often struggle with issues such as intermittent internet connections, screen freezing, inoperative subtitle/ control buttons, and sound synchronization.
Due to a disrupted connection, certain features or control buttons may not function as intended.	
The page is loading slowly, possibly due to high student internet usage.	
Frequent interruptions due to freezing slides.	• These technical glitches mostly impacts to the interaction and engagement of the students in learning the subject.
Not functional subtitles breaking the continuity of engagement	
Misaligned audio and visuals	

The transcribed student interviews reveal that while the Innovative Supplemental Materials (ISMs) are engaging, students often face issues such as pauses, non-functional features, and slow loading times due to intermittent internet connections. These connectivity problems, including freezing screens and audio-visual mismatches, hinder student engagement and learning. Despite the materials being accessible on any device, slow internet speeds remain a significant barrier. To mitigate these issues, the researcher provided offline access to the ISMs, allowing students to use the materials without relying on internet connectivity, thereby enhancing their engagement and overall learning experience. The ISMs are well-regarded, and although some issues arise with the use of online ISMs, the alternative offline ISMs ensured that students still learned significantly.

Despite the challenges, the students had great time using the creative extra resources. They experienced some issues such as internet connectivity issues, freezing slides, and inoperative subtitle/control buttons which led them to come up with solutions for overcoming it. Below are some of their suggestions:

Student K – *Kung maglag na gane, e off tapos e on da pagbalik ang wifi (router) kay taod taod mobalik na dayon siya (signal).* [If it seems lagging, just turning off the router and then turning it on again will restore the signal.]

Student L – *Ang (internet) signal, e refresh da ang page.* [The internet signal, just refresh the page.]

As students become aware of technological advancements, they have already gained the ability to handle minor internet connectivity issues, as demonstrated in their daily use of personal devices (Wang & Na, 2023). In this era of technological advancements, skills about ICT are very handy to move forward in much better advancement as education also is changing and gaining knowledge accompanies gaining of ability to overcome minor issues.

Challenges encountered by the Teachers utilizing the ISMs

The following discussions show the difficulties teachers encounter when utilizing innovative supplemental materials. The interviews and reflection notes gathered during the focus group discussions were transcribed, analyzed, and grouped themes.

Technical Glitches – Internet Problem. Students were not the only ones having difficulties and issues regarding internet connections, teachers and educators also experienced slow connections which hampered online work and activities.

Slow internet speeds can lead to interruptions (Layson, 2022) causing the page to

pause and sometimes cause distortions while waiting for more data to load (Hampton et al., 2020). Below are some of the teacher's interviews and reflection notes describing the challenges encountered utilizing the innovative supplemental materials when facilitating the implementation of ISM.

Teacher A – *The ISM is a very good instructional material for learners especially those are now exposed to the technology but since some areas have limited stable internet connection, some technicalities are evident. When I used the ISM earlier in an online manner, sometimes the slide loads slowly which interrupts my pacing and engagement.*

Teacher B – *Although the internet bar in my laptop is a full bar there are still instances that the pages or slides take a long time to view fully, which affected my mood of continuing the ISM which is why I closed it and opened the offline ISM.*

The use of the Internet for learning is seen as a means to improve accessibility, efficiency and quality of learning by facilitating access to resources and service as well as remote exchanges and collaboration (Agyei & Agyei, 2021). Therefore, the internet has become a valuable tool for learning, and teaching. However, sometimes due to the excessive number of users using one single network the connectivity oftentimes reaches its limit which causes slow internet connections and longer page load times (Hampton et al., 2020) leading to interrupted engagement (Gadille et al., 2021).

Presentation Flow. Time spent trying to understand the structure of the presentation is time not spent learning the actual content, leading to inefficient use of learning time (Biwer et al., 2020). Disorganized slides can confuse users, making it difficult for them to follow the logical flow of the presentation. A lack of clear structure can hinder understanding, as users may struggle to see how different points connect (Biwer et al., 2020). Without elaboration, their meaning may not be clear to all users, leading to confusion.

Teacher A – *I was trying to figure out how to navigate the material in case the students asked me to return to four slides from the current page… then later I successfully found the icon, it's a bit confusing on the first use.*

Teacher B – *Upon using the material, some icons were confusing because there were no page numbers on each slide so I needed to familiarize the icons first and the corresponding information inside them. It was my first use but the more I explored the material, the more I knew where to click first and next and I found myself enjoying using it.*

According to Okeke & Ajadi (2023), instructional materials alone cannot accomplish any of the associated values. Their relevance depends on what the instructor does with them. This indicates that the way in which these resources are handled and used in the classroom is very important. Hence, teachers need to know how to use and manage instructional materials if they are to be used in a meaningful way. Furthermore, Okeke & Ajadi (2023), emphasizes that it is required for the teacher who employs these tools to focus students' attention on the utilization of the teaching resources throughout lesson delivery.

The challenges faced by teachers and student-users, specifically the internet connectivity issues, were carefully considered in the final enhancement of the ISMs. To address these problems, the materials were optimized for offline access, ensuring that both students and teachers could use them without relying on stable internet connections. Additionally, the structure and navigation of the materials were improved to make them more user-friendly, allowing for a smoother and more efficient teaching and learning experience. These enhancements aimed to

mitigate the technical and usability issues, ultimately improving the effectiveness of the ISMs in various educational settings.

Conclusion

The study identified the least-learned competencies of eighth-grade students in physics, including the second and third laws of motion, kinetic and potential energy, Ohm's law, and series and parallel circuits, highlighting struggles with abstract concepts and limited instructional resources.

The developed innovative supplemental materials (ISMs) were highly regarded by experts, rated "Very Satisfactory" in content, instructional, and technical quality, and praised for their comprehensive coverage, alignment with learning objectives, and engaging design.

The ISMs received high ratings from student-users for visual quality, learning environment, and digital interface, significantly enhancing student motivation, engagement, and understanding despite minor technical issues.

Students from Gamut National High School, Badong National High School, and Alba Integrated School showed significant improvement in posttest scores, with mean gain scores over 7 points, reflecting increased knowledge and understanding through the use of ISMs.

There was no significant difference in posttest results across the three schools (ρ-value of 0.584), indicating that the ISMs were equally effective in all schools, supporting the acceptance of the null hypothesis.

Students and teachers faced challenges with internet connectivity when using ISMs, but these issues were mitigated by enhancing the ISMs with offline access options and improved navigation, ensuring a more reliable and engaging learning experience.

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