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Development and Validation of Game-based lesson in teaching Grade-8 Electricity

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Abstract
This study addressed the persistent challenge of low science literacy in the Philippines, particularly in teaching abstract topics like electricity. Despite the pedagogical potential of Digital Game-Based Learning (DGBL), its application is limited by a scarcity of validated instructional materials and a lack of teacher training. To address this gap, a game-based lesson was developed based on the DiGIBST pedagogical model and underwent a rigorous evaluation process. Three science teachers, acting as expert evaluators, assessed the lesson plan using a structured rating sheet focused on planning, content, pedagogy, and DiGIBST integration. Additionally, a pilot test was conducted with 35 Grade 8 students. The evaluation results, including ratings of "Good" and "Satisfactory" from the teachers and qualitative insights from interviews, provided crucial empirical data. The interviews revealed that the lesson was effective in enhancing student engagement and conceptual understanding, with participants highlighting the game's hands-on nature and its ability to provide a safe environment for learning about a dangerous topic. However, feedback from both groups also identified significant technical limitations, such as device lag, which posed a major barrier to effective implementation. Based on these insights, the game-based lesson was revised to enhance its pedagogical and practical effectiveness, contributing a contextually grounded and empirically tested instructional material to the Philippine educational landscape.

Keywords: STEM Education; DGBL; Game-based lesson; Electricity; series and parallel circuit

1. Introduction

Science education in the Philippines continues to face persistent challenges, as evidenced by consistently low performance in international assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). In the 2018 PISA cycle, Filipino students ranked among the lowest globally in science literacy, demonstrating difficulty in applying scientific concepts to real-world contexts (Abenes et al., 2020). Similarly, TIMSS results have highlighted poor performance in Grade 8 science, particularly in physics domains such as force, motion, energy, and electricity (Orleans, 1994; Capistrano, 1999 as cited in Orleans, 2007; Calacal, 1999 as cited in Orleans, 2007). These findings underscore the urgent need for instructional innovations that promote conceptual understanding, learner engagement, and contextual relevance.

The Relevance of Science Education (ROSE) Project, conducted in 2010, revealed a paradoxical relationship between students' cognitive performance and their attitudinal dispositions toward science. Sjøberg and Schreiner (2010) found that students from countries with lower achievement scores—including the Philippines—often expressed higher interest and more positive attitudes toward school science. In contrast, students from high-performing countries such as Finland and Japan tended to view science as obligatory rather than intrinsically engaging. This paradox suggests that Filipino students possess a strong motivational disposition toward science learning, but may be hindered by pedagogical limitations and the abstract nature of certain topics, such as electricity.

One instructional approach that has shown promise in addressing these challenges is Game-Based Learning (GBL). In the Philippine context, Tolentino and Roleda (2017) demonstrated that gamified physics instruction significantly improved student achievement and motivation. Bangcaya et al. (2021) specifically examined gamified activities in electricity, reporting increased engagement and conceptual understanding. Abenes et al. (2020) and Morales (2017) further emphasized the value of culturally relevant and interactive game-based modules in enhancing physics learning outcomes. These studies provide a foundation for the integration of digital technologies into game-based instruction.

Building on the principles of GBL, Digital Game-Based Learning (DGBL) has emerged as a pedagogical innovation that leverages interactive, technology-enhanced environments to facilitate science learning. DGBL enables learners to explore scientific concepts through immersive simulations and risk-free experimentation, thereby enhancing motivation, retention, and real-world application (Eastwood & Sadler, 2013; Huang, 2011; Papastergiou, 2009; Potutan et al., 2019; Caparoso, 2013). The National Science Teacher Association (2007) advocates for interactive activities as essential components of effective physics instruction, and recent studies affirm DGBL's effectiveness in improving both instructional quality and learner outcomes (Abenes et al., 2020; Wang, 2022; Yildirim & Baran, 2020; Zeng et al., 2020).

Despite its potential, Filipino physics teachers have expressed the need for pedagogical models that are specifically tailored to the DGBL context (Diate & Mordeno, 2021). Innovative pedagogy—characterized by creativity, adaptability, and student-centered design—offers multiple advantages, including enhanced learner engagement, collaborative learning, and long-term retention (Akpen et al., 2024; Donoghue & Hattie, 2021; Mettas & Constantinou, 2008; Ruijan et al., 2023; Tanghian Laid & Adlaon, 2025). These approaches are particularly relevant in teaching abstract scientific concepts such as electricity, where visualization and interaction are critical to understanding.

In response to this pedagogical need, Caparoso and Orleans (2024) proposed the Digital Game-Based Learning for Inquiry-Based Science Teaching (DiGIBST) model. Designed specifically for junior high school science in the Philippines, DiGIBST integrates serious games with inquiry-based strategies and clearly defined teacher roles. The model aims to improve students' attitudes toward physics and enhance their conceptual understanding, particularly in challenging topics like electricity.

Anchored in the DiGIBST framework, this study focuses on the development and validation of a digital game-based lesson in teaching Grade 8 electricity. The instructional resource features Wired, a serious science game that simulates electrical concepts through interactive gameplay. Grounded in constructivist and inquiry-based principles, the lesson is aligned with the Philippine junior high school science curriculum and is designed to promote engagement, conceptual clarity, and curriculum coherence

2. Statement of the Problem

Despite the pedagogical potential of DGBL, its application in Filipino classrooms remains limited and underexplored—particularly in teaching complex topics like electricity. Students often lack engagement, while teachers struggle to implement game-based approaches due to insufficient training, resources, and validated instructional materials. Furthermore, there is a scarcity of research on the development of structured game-based lessons informed by pedagogical models that suit the Philippine educational landscape. This gap calls for innovative teaching strategies that are both contextually grounded and empirically tested.

3. Objectives of the Study

This study aimed to:

1. Develop a game-based lesson on electricity based on the DiGIBST pedagogical model;
2. Evaluate the game-based lesson on electricity;
3. Revise the game-based lesson.

4. Methodology

The following procedures in order are the specified steps how the game-based lesson was developed.

4.1 Data Gathering Procedure

The study adopted a developmental research design, allowing the researcher to iteratively develop and refine the game-based lesson based on expert feedback from science teachers.

4.2 Selection of the Serious Game

For the game-based lesson to be developed, the researcher first identified a suitable serious game for teaching Grade-8 electricity concepts, following the criteria set by Caparoso and Orleans (2022). These criteria included (a) game elements and feedback mechanisms, (b) alignment with the science curriculum, (c) learning affordances, and (d) suitability for infrastructure and target users. Using a scoring system with a maximum of 21 points, the researcher evaluated five online serious games. Among them, Wired by the University of Cambridge received the highest score of 20 points, making it the most suitable choice. A comprehensive review of Wired was conducted to assess its features and educational benefits.

Table 1 summarizes the evaluation of five serious games against criteria set by Caparoso and Orleans (2022) for their suitability in teaching Grade 8 electricity. The game Wired received the highest score, indicating it was the most suitable for the developed game-based lesson.

Table 1: Serious Games' Ratings

Name of the Game	Score
Charge Everything by SilverGames.Com	14
Light Bulb Parts by planeta42.com	11
Find the hidden dangers by lge-ku.e-smartkids.com	16
Turn on the lightbulbs in the circuit by cokogames.com	11
Wired	20

4.3 Designing and Development of the Game-based lesson

The researcher designed a comprehensive game-based lesson that clearly defines its objectives and incorporates the seven phases of the 7E instructional model, seamlessly integrated with the DiGIBST pedagogical framework. This approach ensures an engaging and structured learning experience, fostering deeper understanding and active participation. The lesson strategically combines interactive gameplay with educational principles to enhance student engagement, critical thinking, and knowledge retention.

4.4 Conference of Science Teachers

Last September 2024, all science teachers of a selected public school attended a conference for the introduction of the DiGIBST pedagogical model, and the Wired game. The researcher also explained the study and the game-based lesson. The conference aimed to provide the teachers with a comprehensive understanding of the Wired game, the DiGIBST pedagogical model, and the game-based lesson. Furthermore, the researcher introduced various serious games across the disciplines of Biology, Chemistry, Earth and Space Science, and Physics, highlighting their potential applications for instructional purposes.

4.5 Expert Validation

Following the conference of science educators, three selected science teachers were assigned as evaluators to assess the quality of the developed game-based lesson. The evaluation process was conducted using a structured rating sheet designed by the researcher to ensure a systematic and objective assessment. The criteria for evaluation encompassed three key aspects: planning and organization, which examined the coherence and clarity of the lesson structure; content and pedagogy, which assessed the accuracy, relevance, and instructional effectiveness of the material; and DiGIBST pedagogical integration, which evaluated the incorporation of digital and game-based learning strategies to enhance student engagement and comprehension.

The selection of these science teachers as expert evaluators was based on their extensive experience in science education, pedagogical expertise, and familiarity with curriculum development. Each evaluator possessed a strong background in instructional design and had prior experience in assessing educational materials for alignment with academic standards. Moreover, their proficiency in integrating innovative teaching methods, including digital and game-based learning, ensured a well-informed and critical analysis of the developed lesson. Their insights provided valuable recommendations for refining the lesson and enhancing its effectiveness in meeting learning objectives.

4.6 Pilot Testing

A pilot test was conducted to evaluate the initial version of the game-based lesson on electricity developed under the DiGIBST pedagogical model. The pilot testing aimed to assess the lesson’s clarity, usability, instructional alignment, and overall effectiveness in promoting student engagement and conceptual understanding.

The pilot was carried out in the same junior high school where the participating science teachers were based, ensuring contextual consistency and relevance. One Grade 8 section, composed of 35 students, was purposively selected to participate in the pilot phase. The selection was based on accessibility, teacher availability, and the section’s readiness to engage with digital learning tools.

During the pilot session, students interacted with the Wired digital game, which was integrated into a structured lesson plan aligned with the Philippine science curriculum. The session was facilitated by the teacher who had previously undergone orientation on the DiGIBST framework. To document the instructional flow, learner responses, and technical performance of the game, data were gathered exclusively through interviews.

The pilot testing provided valuable insights into the lesson's strengths and areas for improvement. Feedback from both students and teachers informed subsequent revisions to the instructional design, including adjustments to game complexity, pacing, scaffolding strategies, and technical support provisions. These refinements ensured that the final version of the game-based lesson was pedagogically sound, contextually appropriate, and responsive to learner needs.

4.7 Data Analysis

The mean was employed as the statistical measure for analyzing the ratings in the evaluation of the game-based lesson, ensuring an objective assessment of lesson quality. The scoring system was categorized into five distinct levels: 15-13 points corresponded to an excellent rating, 12-10 points indicated a good rating, 9-7 points reflected a satisfactory rating, 6-4 points signified a poor rating, and 3-1 points denoted an unacceptable rating. The final evaluation of the lesson plans was expected to achieve an excellent rating, demonstrating their effectiveness in meeting educational objectives. Additionally, teachers' and students' comments and suggestions were systematically compiled and analyzed using a thematic analysis to provide insights for further refinement and enhancement of the lessons.

4.8 Revision

Based on the evaluators' comments and suggestions, the game-based lesson was refined to enhance its key components and ensure its effectiveness.

5. Results and Discussion

The researcher developed the game-based lesson by first selecting a learning competency. Based on conducted comprehensive review of the Wired game by the researcher, the game coincides with the most essential learning competencies (MELCS) inferring the relationship between current and voltage, identifying series and parallel circuits, explaining the advantages and disadvantages of series and parallel connections in homes, and explaining the functions of circuit breakers, fuses, earthing, double insulation, and other safety devices. These MELCS typically covered over a three-week instructional period. Thus, the researcher then unpacked these MELCS and selected specific objectives, structuring them into achievable and realistic time frames. After that, the researcher integrated the 7E lesson and DiGIBST phases with the game and other activities. The table below shows the comprehensive details of the game-based lesson on a learning plan type.

Table 2: Learning Plan of the Developed Game-based Lesson

Day	7E & DiGIBST Phase	Objective/s	Method	Bloom's Revised Taxonomy Category
1	• Elicit (Orient & Explore)	Review	Oral Questioning	Remembering
	• Engage (Orient & Explore)	Describe the components of a basic electric circuit.	DGBL and Oral Questioning	Understanding and Applying
	• Explore (Guided Play)	Differentiate the properties of series and parallel circuits.	DGBL	Applying
2	• Explore (Guided Play)	Differentiate the properties of series and parallel circuits. .	DGBL	Applying

	• Explain (Debrief and Discuss)	Describe the components of a basic electric circuit. Differentiate the properties of series and parallel circuits. Determine advantages and disadvantages of series and parallel connections	DGBL and Oral Questioning	Remembering, Understanding, Applying, Analyzing
3	• Explain (Debrief and Discuss)	Describe the components of a basic electric circuit. Differentiate the properties of series and parallel circuits. Determine advantages and disadvantages of series and parallel connections.	DGBL and Oral Questioning	Remembering, Understanding, Applying, Analyzing
	• Elaborate (Assess) •	Differentiate the properties of series and parallel circuits.	Paper and Pen Test	Evaluating
	• Extend (Assess)	Combination circuits	Oral Questioning	Understanding and Applying
	• Evaluate (Assess)	Describe the components of a basic electric circuit. Differentiate the properties of series and parallel circuits. Determine advantages and disadvantages of series and parallel connections	Paper and Pen Test	Remembering, Understanding, Applying, Analyzing

The developed game-based lesson, detailed in Table 2, outlines a three-day, structured pedagogical approach that integrates the 7E instructional model with the DiGIBST framework. This systematic plan guides learners through progressively challenging cognitive levels. The initial phases—Elicit and Engage—focus on activating prior knowledge and introducing fundamental concepts, targeting the Remembering and Understanding levels of Bloom's Revised Taxonomy.

Through the Explore and Explain phases, learners use DGBL and oral questioning to differentiate circuit properties and analyze advantages and disadvantages of series and parallel connections, thereby fostering higher-order thinking skills such as Applying and Analyzing.

The lesson culminates in comprehensive assessment opportunities within the Elaborate, Extend, and Evaluate phases, which use a combination of paper-and-pen tests and oral questioning to measure understanding across all primary objectives.

Three science teachers from a public school evaluated the game-based lesson. Table 3 presents a summary of their responses. The questionnaire used had undergone a series of evaluations by the panel prior to its distribution. Specifically, it contained items related to planning and organization, content and pedagogy, and the integration of the DiGIBST pedagogical model.

Table 3: Teachers' Ratings and Suggestions

Science Teacher	Comments and/or Suggestions	Assessment Given
1	• Break down the objective into manageable tasks. • Modify the lesson to be more realistic and fit into an achievable timetable. • Revise the elaborate activity to ensure it aligns with your objectives. • Provide clear definitions for necessary terms	Good
2	• Select a single objective for your lesson plan, as the preselected objectives were unattainable within the given time frame. • With the chosen objective, specify subtasks necessary to achieve the main task. • Add unlocking of difficult terms in the engage part of the lesson. Revise the elaborate activity to ensure it aligns with your objectives. • Ensure that learners have thoroughly understood the science concepts through in-game activities.	Satisfactory
3	• Adjust the time according to the pacing of Grade-8 students. • Choose one specific objective and make subtasks according to it. • Revise the elaborate activity to ensure it aligns with your objectives. • Ensure that all learners, regardless of their pace—whether slow, average, or fast—are given the opportunity to participate and engage in the discussion.	Good

As summarized in Table 3, the three expert evaluators provided detailed feedback and rated the lesson plans as Good and Satisfactory. The feedback highlighted three recurring themes for revision: the need to refine objectives into more manageable and realistic goals, adjusting the lesson's pacing to fit an achievable timetable, and ensuring all activities are aligned with the stated learning objectives. The teachers' comments also emphasized the importance of defining key terms and fostering inclusive participation among students. This constructive guidance was crucial for refining the pedagogical design and practical effectiveness of the game-based lesson.

Table 4 summarizes the qualitative feedback from interviews with learners and teachers, providing critical insights into the implementation of the game-based lesson. The data is categorized into four key themes that directly address the research objectives: Engagement in Learning, Preferred Aspects of the Lesson, Effectiveness for Learning, and Technical Limitations. This qualitative approach offers a nuanced understanding of the pedagogical and practical aspects of the lesson from the participants' perspectives. The inclusion of direct quotes as sample responses allows for a richer, more contextualized evaluation of the lesson's strengths and weaknesses, aligning with the study's aim to develop and validate a structured, contextually grounded instructional material for Filipino classrooms. This method not only evaluates the lesson's efficacy but also reveals key challenges that are crucial for the revision phase, ultimately contributing to a validated instructional material that can be effectively implemented in the local educational landscape.

Table 4: Learners' and Teachers' Responses from Interviews

Themes	Sample Responses
Engagement in Learning	"The game was enjoyable." (Case 1)
	"The game was engaging but difficult." (Case 7)
	"The students enjoyed the lesson." (Case 9)
Preferred Aspects of the Lesson	"My favorite part was the game." (Case 3)
	"I liked the hands-on aspect." (Case 4)
	"I liked how, when we were connecting the wires in the game, it felt like we were solving a real problem." (Case 5)
Effectiveness for Learning	"Yes, it helped with understanding." (Case 6)
	"Yes, it helped us—especially because electricity is dangerous." (Case 2)
Technical Limitations	"The devices were slow." (Case 5)
	"My device lagged a lot." (Case 8)

The analysis reveals that the game-based approach was generally well-received by students, with many expressing enjoyment and heightened engagement. Responses such as "The game was enjoyable" and "The students enjoyed the lesson" underscore the positive emotional and behavioral engagement fostered by the game. The interactive and immersive nature of the game contributed to a more engaging learning experience compared to traditional methods, which aligns with extensive findings in educational research highlighting the motivational potential of game-based learning (Dede et al., 2009; Kearney et al., 2012; Ullah et al., 2022). While teachers observed this heightened student engagement, they raised a crucial pedagogical concern: whether the engagement directly translated into a deeper conceptual understanding. This is a common challenge in DGBL, as enjoyment does not always correlate with improved learning outcomes (Ullah et al., 2022). Teachers noted that while students were focused and collaborative, some still required assistance to fully comprehend the lesson objectives, indicating that while the game is effective in boosting engagement, structured guidance and reinforcement may be needed to ensure this engagement aligns with learning goals.

The second theme, Preferred Aspects of the Lesson provides specific feedback on what elements of the lesson were most successful. The sample response, "My favorite part was the game," confirms that the game-based activity was a significant highlight for participants. This preference for the game-based format over traditional instruction validates the study's premise that DGBL can serve as an innovative and appealing alternative for teaching complex topics. The positive reception of the game element suggests that the lesson's design, which integrates educational content with a fun, interactive medium, was a success. This reinforces the value of using game mechanics to create a learner-centered experience that feels less like work and more like play, thereby sustaining motivation and interest.

The third theme, Effectiveness for Learning directly addresses the core purpose of the DGBL lesson: its ability to facilitate learning. The responses "I liked the hands-on aspect" and "Yes, it helped with understanding" suggest that the approach was an effective way to learn about circuits. Furthermore, the response "it helped us—especially because electricity is dangerous" highlights a unique and valuable outcome of the game. By simulating a high-risk topic in a safe environment, the lesson allowed students to engage in exploratory learning and understand the real-world implications of their actions without consequence. Teachers recognized the game's potential for application-based learning, noting that it promoted problem-solving and collaboration. However, they also suggested pairing the game with simpler simulations for initial concept introduction, which could provide students with the foundational knowledge needed for the more complex game. This finding is crucial as it suggests that a scaffolded approach, where simpler tools build into a more complex game, can prevent cognitive overload and enhance learning outcomes.

The fourth theme, Technical Limitations identifies significant barriers to implementation. Responses like "The devices were slow" and "My device lagged a lot" highlight technical issues that directly impacted the learning experience. These problems frustrated students and disrupted the lesson's flow, making it challenging for them to maintain focus and fully achieve learning objectives. Teachers echoed these concerns, indicating that technical limitations are a major barrier to implementing game-based learning in public school settings, where resources and infrastructure are often limited. This finding validates a key problem identified in the study's Statement of the Problem and underscores the need for a practical and accessible design. It also highlights the reality that for DGBL to be a viable and equitable instructional strategy in the Philippine context, schools must have access to updated technology, reliable internet, and technical support.

Based on the comments and suggestions given, the researcher revised the game-based lesson to ensure effectiveness. Table 4 provides the revised learning plan for the revised game-based lesson.

Table 5: Learning Plan of the Revised Game-based Lesson

Day	7E & DiGIBST Phase	Objective/s	Method	Bloom's Revised Taxonomy Category
1	• Elicit (Orient & Explore)	Review	Oral Questioning	Remembering
	• Engage (Orient & Explore)	Compare the characteristics and differences between series and parallel circuits.	DGBL and Oral Questioning	Understanding and Applying
	• Explore (Guided Play)	Compare the characteristics and differences between series and parallel circuits.	DGBL	Applying
2	• Explore (Guided Play)	Compare the characteristics and differences between series and parallel circuits.	DGBL	Applying
	• Explain (Debrief and Discuss)	Define series and parallel connections. Compare the characteristics and differences between series and parallel circuits. Provide examples of series and parallel	DGBL and Oral Questioning	Remembering, Understanding, Applying, Analyzing

		connections through the Wired game.		
3	• Explain (Debrief and Discuss)	Define series and parallel connections. Compare the characteristics and differences between series and parallel circuits. Provide examples of series and parallel connections through the Wired game.	DGBL and Oral Questioning	Remembering, Understanding, Applying, Analyzing
	• Elaborate (Assess)	Identify series and parallel connections.	Paper and Pen Test	Evaluating
	•			
	• Extend (Assess)	Combination circuits	Oral Questioning	Understanding and Applying
	• Evaluate (Assess)	Define series and parallel connections.	Paper and Pen Test	Remembering, Understanding, Applying, Analyzing

Following the feedback from expert evaluators, the lesson plan was revised to streamline the learning objectives and provide a more scaffolded approach to teaching electricity. The revised framework, as shown in Table 5, begins with a focused review of basic circuits before introducing the core objective of comparing series and parallel connections through DGBL.

The Explore and Explain phases are extended to ensure students have ample time to master the concepts through hands-on gameplay and guided discussion, fostering a deeper engagement across multiple cognitive levels, from Remembering to Analyzing. The revision also refined the assessment phases, providing a clearer progression from identifying connections to solving more complex combination circuits. This updated plan reflects a more practical and pedagogically sound approach, directly addressing the teachers' suggestions regarding objective attainability and pacing.

6. Conclusion and Recommendations

The researcher developed a comprehensive game-based lesson integrating the phases of the DiGIBST pedagogical model and the 7E instructional framework. To ensure the lesson's effectiveness, science teachers conducted a thorough evaluation using a rating system with criteria established by the researcher. The evaluation process included an analysis of ratings, summarized comments, suggestions, and interviews which informed the final revisions of the game-based lesson.

Following these refinements, the revised lesson was finalized and prepared for instructional use in a digital game-based learning (DGBL) environment focused on the topic of electricity. To further enhance the implementation of game-based learning, expert evaluators provided recommendations to optimize the learning experience. First, they emphasized the importance of a phased, scaffolded approach, beginning with simpler tools such as PhET simulations before introducing more complex educational games. This progression helps gradual cognitive development and prevents information overload. Second, they advised ensuring sufficient time for game-based activities while addressing technical challenges to improve student engagement and deepen conceptual understanding. Third, they recommended extending the duration of the science teachers' conference to include more technical and knowledge-focused activities, equipping educators with a stronger foundation for implementing game-based learning strategies effectively. Lastly, they suggested prolonging the research period to collect more comprehensive insights and strengthen the evidence supporting the intervention's effectiveness.

These recommendations contribute to the refinement of digital game-based learning practices, ensuring both instructional efficiency and meaningful student learning outcomes.

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Appendices

Appendix A

Criteria for Selecting a Serious Game

Instruction: When evaluating a serious game, please use the following checklist to determine if it meets the necessary criteria. For each statement, indicate whether it applies to the game by placing a check mark (✓) under '**YES**' or '**NO**'. A '**YES**' response is assigned a value of one (**1**), while a '**NO**' response is assigned a value of zero (**0**). According to Caparoso and Orleans (2022), it is important that the game meets all of the criteria to be considered suitable for use.

CRITERIA	Yes	NO
A. Game Elements and Feedback System		
1.The serious game offers a real-world problem for students to solve/investigate or a task/mission to accomplish.		
2.The in-game science topic/concept is correctly presented.		
3.The game narrative/storyline is comprehensible.		
4.The game controls are working.		
5.The game mechanics are easy to follow.		
6.The game is user-friendly– responsive and adaptive to various screen sizes.		
7.The game world is appealing to students.		
8.The game provides relevant feedback to the student all throughout the gameplay.		
9.The system of scoring encourages a student to play more.		
B. Alignment of the Serious Game to the Science Curriculum		
1.The game addresses the competencies of the science topic.		
2.The serious game requires students to apply a science concept.		
3.The time needed to solve/investigate a problem or accomplish a mission/task through the game is reasonable.		
C. Learning Affordances of Serious Games		
1.The game provides an opportunity for students to communicate.		
2.The game provides an opportunity for students to collaborate and learn from each other.		
3.The game requires students to evaluate situations and make decisions.		
4.The serious game will enrich my students' understanding of the science topic.		
5.The serious game allows students to solve a problem or complete a task/mission.		
D. Suitability of the Serious Game to Available Infrastructure and Target User		
1.The serious game's system requirements fit well with the schools' computer units.		
2.My students understand the language used in the game.		
3.The serious game supports various platforms/devices.		
4.My students will like this game.		
5.The serious game's system requirements fit well with the schools' computer units.		
Total		

Adopted from Caparoso & Orleans (2022).

Appendix B
Criteria for Rating the Lesson Plans

Instruction: For the evaluation of lesson plans, please use the given guidelines to check if it fulfills the required conditions. For each criterion, please indicate its applicability by placing a check mark (✓) under the appropriate column, '**YES**' or '**NO**'. A response of '**YES**' is assigned a numerical value of **one** (**1**), whereas a '**NO**' response is assigned a numerical value of **zero** (**0**). The sum of these scores will act as a benchmark to appraise the suitability of the lesson plan for the successful implementation of the study.
Please note that a "NO" doesn't necessarily mean the lesson plan is bad, but rather that there may be areas for improvement. You may also consider providing any comments or suggestions to enhance the lesson plan.

Overall Score	**Corresponding assessment**
15-13	Excellent
12-10	Good
9-7	Satisfactory
6-4	Poor
3-1	Unacceptable

CRITERIA	YES	NO	SUGGESTIONS
A. Planning and Organization			
1. The lesson plan has clear learning objectives aligned with the most essential learning competencies.			
2. The content is appropriate for the grade level and student knowledge.			
3. The timeline is realistic and allows for appropriate pacing.			
4. The lesson plan outlines specific activities and materials required.			
B. Content and Pedagogy			
1. The lesson plan promotes scientific inquiry and critical thinking.			
2. The lesson plan includes opportunities for hands-on learning and active participation.			
3. The lesson plan encourages student engagement and discussion.			
4. The lesson plan encourages opportunities for assessment and feedback integrated throughout the lesson.			
5. The lesson plan incorporates relevant science vocabulary and prior knowledge.			
6. The lesson plan addresses potential misconceptions or common errors.			
C. DiGIBST Pedagogical Model Integration			
1. The lesson plan clearly indicates necessary steps for students to familiarize the game (game world, interface, navigation buttons and controls).			
2. The lesson plan provides opportunities for the students to interact with the game and solve solutions encountered during gameplay.			
3. The lesson plan encourages students to share impressions and what they learn from game.			
4. The lesson plan encourages students to discuss and appreciate in-game science topic.			
5. The lesson plan includes an assessment appropriate to the game-based lesson.			

Appendix C
Interview Guide Questions

For learners
1. How would you describe the Physics class you just attended, especially the part where you played the Wired game about electricity? (Unsa inyong masulti sa Physics class nga inyong giapilan, labi na kadtong bahin sa Wired game nga naghisgot sa kuryente?)
2. Which part of the lesson did you enjoy the most, and why? (Asa nga bahin sa leksyon ang inyong pinaka-paborito ug ngano?)
3. Did the lesson help deepen your understanding of series and parallel connections? (Nakatabang ba ang leksyon sa pagsabot ninyo sa series ug parallel connections?)

For teachers
1. How would you describe the Physics class you observed? In what ways did it differ from your usual science classes?
2. Which part of the lesson did you find most effective or engaging? Why?
3. Do you think the DiGIBST pedagogical model enhanced the integration of games in the lesson compared to simply using the game without a structured approach? If yes, how did it improve the implementation? If not, what challenges or limitations did you observe?