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EFFECTS OF DIGITAL GAME UTILIZATION ON THE MATHEMATICS PERFORMANCE OF GRADE 7 LEARNERS

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ABSTRACT

This study explored the impact of digital games on Grade 7 learners' mathematics performance at San Dionisio Integrated School during the school year 2025–2026. Learners were selected through purposive sampling and participated in a digital game-based intervention. Pretest results showed low mathematics performance among learners. Post-test outcomes indicated improvement to a moderate level, with a statistically significant increase in scores after the intervention as determined using the Wilcoxon signed-rank test. The results suggest that digital games effectively promote active learning, engagement, collaboration, and improved understanding of mathematical concepts. Thematic analysis further revealed a positive shift in learners' perceptions, transforming mathematics from a difficult subject into an engaging and interactive experience that encouraged peer-to-peer mentoring (binuligay). By integrating game-based elements and interactive tasks, digital games enhance motivation and participation among learners. The study recommends integrating digital games into the mathematics curriculum, particularly for learners who require additional support. Systematic use of this approach may lead to improved academic performance and foster a more engaging and inclusive learning environment. Continued research is needed to evaluate its long-term impact and applicability across different educational contexts.

INDEX TERMS: *Digital Games, Mathematics Performance, Grade 7 Learners, Gamified Learning, Academic Achievement*

I. INTRODUCTION

Mathematics is a fundamental subject in basic education that equips learners with essential skills for problem-solving, logical reasoning, and daily decision-making. However, the COVID-19 pandemic significantly disrupted the educational system, creating learning gaps and challenges in delivering quality instruction, particularly in mathematics. The shift in learning modalities affected students' engagement and understanding, making it more difficult for them to grasp mathematical concepts and progress academically. Despite these challenges, schools and educators continue to implement interventions to ensure that learning persists and that students acquire the necessary competencies for their academic development.

Filipino students have consistently performed poorly in international assessments such as the Trends in International Mathematics and Science Study (TIMSS), where the Philippines ranked among the lowest-performing countries, with scores declining over time. These results highlight the persistent issue in mathematics education and the urgent need for effective instructional strategies to improve learners' performance. In response, the Department of Education has taken initiatives to better prepare students for global assessments and enhance the quality of education.

At the local level, data from San Dionisio Integrated School revealed that Grade 7 learners obtained a low Mean Percentile Score of 68.96% in Mathematics. Additionally, results from the Regional Unified Numeracy Test showed a considerable percentage of non-numerate learners, with only minimal improvement from pre-test to post-test. These findings indicate a strong need for innovative and effective learning interventions to enhance students' numeracy skills and overall mathematics performance.

Digital game-based learning (DGBL) has emerged as an effective approach in improving student engagement, motivation, and critical thinking. This strategy allows learners to actively participate in the learning process through interactive and enjoyable activities, making complex mathematical concepts easier to understand. Studies have shown that game-based learning positively influences both cognitive and affective domains, including achievement, attitude, motivation, and interest in mathematics.

Given the current situation in mathematics education, particularly at San Dionisio Integrated School, the researcher identified the need to implement an engaging and effective instructional strategy. Thus, this study utilized Math Digital Games as a classroom-based learning intervention for Grade 7 learners during the School Year 2022–2023 to determine its effectiveness in enhancing their mathematics performance.

II. LITERATURE REVIEW

A. Digital Games and Game-Based Learning Applications

Digital Game-Based Learning (DGBL) has become an increasingly significant approach in education, widely recognized for its ability to enhance student motivation and engagement through interactive game mechanics such as rewards, challenges, and feedback systems (Nguyen et al., 2024). This approach has been applied across various subjects, particularly in mathematics, where learners often struggle with engagement and conceptual understanding.

Several digital applications have been developed to support mathematics learning. Math Missile, for instance, provides diverse exercises that allow students to practice mathematical skills in an engaging and interactive environment, although its use as a formal learning intervention remains limited in research. Similarly, Wordwall has been identified as an effective tool for creating interactive and game-based activities that help reduce classroom monotony and increase student participation (Agung, 2021). Studies suggest that Wordwall enhances learners' interest and engagement, although it has

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certain limitations such as restricted features without subscription (Andi, 2022).

Other platforms, such as Integer Warp, promote accuracy and speed in solving mathematical problems through competitive and interactive gameplay, while Mathigon offers a comprehensive digital learning environment that integrates simulations, storytelling, and personalized instruction to foster critical thinking and problem-solving skills (Rivero, 2020). Additionally, ClassPoint enables teachers to incorporate gamified quizzes into lessons, increasing student participation and engagement in both face-to-face and digital learning environments (Morata & Caballes, 2024).

Overall, the reviewed literature demonstrates that digital game-based tools provide interactive, engaging, and effective learning experiences in mathematics. These platforms support both cognitive and affective development, making them valuable instructional interventions. However, despite the availability of various applications, there remains a need to explore and evaluate specific tools, such as Math Digital Games, in improving students' mathematics performance, thereby supporting the rationale for the present study.

B. Digital game-based learning

Game-based learning (GBL) is an instructional approach that uses digital and non-digital games to help learners acquire new knowledge and skills (Grace, 2019). Studies show that the integration of games in education leads to improved learning outcomes and overall academic performance (Kula, 2021; Syafii, 2021). This approach enhances learning by motivating students to apply knowledge in decision-making, evaluate outcomes based on their actions, and engage in meaningful communication and collaboration with peers, which also improves social skills (Boctor, 2013).

Research also indicates that game-based learning increases students' interest and motivation by providing engaging and enjoyable learning experiences. It allows learners to realize that learning is not limited to traditional classroom instruction but can also occur through interactive and self-directed activities, resulting in higher engagement (Jasni et al., 2019). Additionally, GBL supports the development of positive learning behaviors such as patience, persistence, teamwork, and healthy competition, which contribute to goal-oriented learning (Ding et al., 2018).

The growing global use of game-based learning platforms further highlights its effectiveness in education. Tools such as Minecraft: Education Edition are increasingly used in schools to teach various subjects, including mathematics, science, and history, demonstrating the broad applicability and potential of this learning approach (Minecraft: Education Edition, 2021).

Overall, the literature supports game-based learning as an effective instructional strategy that enhances motivation, engagement, collaboration, and academic performance, making it a relevant approach for improving learning outcomes in education.

C. Effectiveness of Digital Games in Mathematics Education

Gamification and game-based learning (GBL) have emerged as innovative instructional approaches that enhance student engagement, motivation, and learning outcomes across various educational contexts. Gamification involves the use of game elements such as points, badges, leaderboards, and rewards in non-game settings to encourage participation and improve performance. Studies have shown that these strategies are particularly effective in mathematics education, where they support student interest and achievement (Lee, 2023).

Research indicates that integrating game-based learning into mathematics instruction helps make learning more engaging and meaningful. Teachers utilize technology-based and research-supported instructional materials to improve lesson delivery and address learning challenges (Clements & Wright, 2022). Studies also suggest that student performance is influenced more by the instructional materials used than by teaching quality alone (Sapin, 2022). Evidence from research shows that students exposed to game-based math programs demonstrate improved mathematical skills compared to those in traditional learning environments (Kirschner et al., 2009).

In the 21st century, GBL has become a widely recognized educational trend that promotes student-centered learning and improves learning efficiency (Ahmad & Iksan, 2021; Zou, 2020). It combines entertainment and education, making learning more interactive while fostering critical thinking, patience, and problem-solving skills (Lasut & Bawengan, 2020; Liu et al., 2021). Furthermore, gamification supports motivation through elements such as competition, rewards, and feedback systems, which are widely used in higher education and other learning environments (Pho et al., 2015; Kim, 2013).

Studies also highlight the positive effects of game-based learning on academic achievement, motivation, classroom dynamics, and affective learning domains such as interest and engagement (Sharples, 2000; Hui, 2023). Additionally, GBL promotes both cognitive and affective development by allowing students to actively engage with concepts through simulations and interactive tasks (Tamosevicius, 2022).

Empirical findings further confirm that game-based learning improves mathematics performance, attitude, and conceptual understanding while reducing math anxiety and enhancing social-emotional skills (Sahin et al., 2020; Baul & Mahmud, 2021). Overall, the literature strongly supports the integration of gamification and game-based learning in mathematics instruction as effective strategies for improving learner engagement, motivation, and academic performance.

D. Mathematics Performance

Mathematics is considered a foundational discipline that develops logical thinking, problem-solving, and analytical skills, yet it is often perceived by students as difficult and uninteresting due to its abstract nature and complex concepts. Despite its importance in personal and national development, students' performance in mathematics has remained low, as shown in both national and international assessments such as PISA and TIMSS, where Filipino learners consistently ranked

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below proficiency standards (OECD, 2019; DepEd, 2019). This persistent challenge has been further intensified by the COVID-19 pandemic, which widened learning gaps and affected the delivery of mathematics instruction (Sooknanan et al., 2023; Torres, 2021).

In response to these challenges, the Department of Education implemented the Most Essential Learning Competencies (MELCs) to guide instruction and ensure learning continuity across grade levels. Grade 7 mathematics covers a wide range of competencies that emphasize number sense, geometry, algebra, statistics, and problem-solving skills, all of which aim to develop learners' mathematical proficiency and critical thinking skills (DepEd, 2016). However, traditional lecture-based instruction has been found to be insufficient in engaging learners and developing higher-order thinking skills needed in real-world problem-solving (Lee, 2023).

To address these concerns, studies have highlighted the effectiveness of digital tools and innovative instructional strategies in improving mathematics performance. Tools such as Math Missile, Wordwall, Integer Warp, and Mathigon provide interactive and engaging platforms that support visualization, practice, and personalized learning experiences. Research shows that these digital applications promote active engagement, motivation, collaboration, and deeper understanding of mathematical concepts among learners (Schindler et al., 2017; NCTM, 2014). Additionally, learner-centered approaches supported by technology have been found to improve retention and academic performance when aligned with curriculum standards (Hattie, 2009; DepEd, 2016).

Overall, the literature emphasizes that integrating digital tools and innovative instructional approaches in mathematics education is essential in addressing learning gaps, improving student engagement, and enhancing academic performance, particularly among Grade 7 learners.

III. PURPOSE OF THE STUDY

This study generally aimed to evaluate the effectiveness of Digital Games in enhancing the Mathematics performance of San Dionisio Integrated School Grade 7 learner school year 2025-2026 while simultaneously exploring their qualitative learning experiences during the integration of these digital tools.

Specifically, it sought answers to the following questions:

1. What is the level of Mathematics performance of Grade 7 Junior High School learners prior to utilization of digital games as shown in their pretest scores?
2. What is the level of Mathematics performance of Grade 7 Junior High School learners after utilization of digital games as shown in their posttest scores?
3. Is there a significant difference in the level of Mathematics performance of Grade 7 Junior High School learners prior to and after utilization of digital games as shown in their pretest and posttest scores?
4. What are the learning experiences of the Grade 7 learners in utilizing Digital Game- Based Learning (DGBL)?

IV. THEORETICAL FRAMEWORK

This study is anchored on Game-Based Learning (GBL), which refers to learning that occurs through game play with defined educational outcomes (Shaffer et al., 2005). Digital Game-Based Learning (DGBL) has gained increasing attention in both research and education as an effective approach to address student disengagement and promote active learning in mathematics (Nguyen et al., 2024). The integration of game elements such as challenges, feedback, and rewards helps create a more engaging and motivating learning environment (Prensky, 2001; Oustlund, 2008).

The theoretical foundation is also supported by Piaget's theory of cognitive development, which emphasizes that play plays a crucial role in learning by helping children develop and refine concepts as they progress through developmental stages. Additionally, game-based learning is recognized as an effective strategy for promoting critical thinking and active engagement in classroom instruction (Icard, 2014).

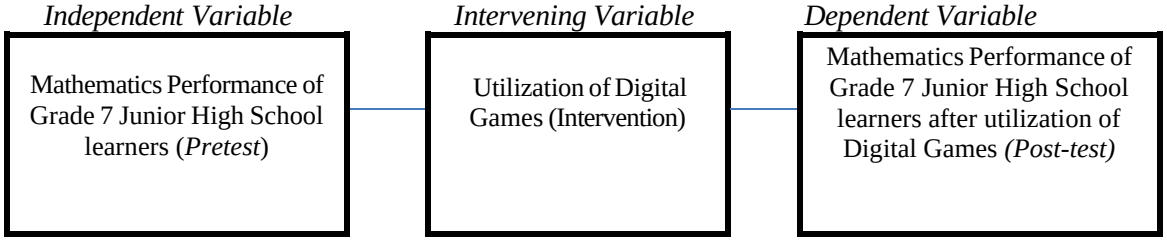
Empirical studies further support the effectiveness of GBL in mathematics education. Hui (2023) found that game-based learning positively influences both cognitive and affective domains, improving mathematical knowledge, skills, motivation, interest, and engagement. This highlights the dual role of GBL in enhancing both academic performance and learner attitude toward mathematics.

In this study, the conceptual framework follows a pretest–intervention–posttest design. The independent variable is the utilization of digital games as an instructional intervention, while the dependent variable is the mathematics performance of Grade 7 learners after the intervention. The pretest measures the initial mathematics performance, and the posttest evaluates the improvement after exposure to digital game-based learning.

V. CONCEPTUAL FRAMEWORK

The paradigm of the study is shown below:

Figure 1: Research paradigm illustrating the independent, intervening and dependent variables.



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The figure shows the utilization of digital games as an intervention in improving mathematics performance among Grade 7 Junior High School learners. The independent variable is the mathematics performance of the learners based on the pretest, while the intervening variable is the utilization of digital games. The dependent variable is the mathematics performance of the learners after the utilization of digital games, as measured by the post-test.

METHODOLOGY

A. Research Design

This study employed a quasi-experimental research design, specifically a one-group pretest–posttest approach, to determine the effectiveness of digital games in improving the mathematics performance of Grade 7 learners.

B. Subjects of the Study

The study involved 23 Grade 7 learners from San Dionisio Integrated School in San Rafael, Iloilo. The section taught by the teacher-researcher was utilized to manage and control the various stages of experimentation throughout the conduct of the study

C. Research Instrument

To gather the data needed in this study, a researcher-made, validated, and pilot-tested "pre-test" in mathematics was used. This research instrument consisted of a 45-item test.

D. Data Gathering Procedure

The researcher secured permission from school authorities and prepared consent letters for the respondents prior to the conduct of the study. A 40-item researcher-made multiple-choice test was developed, validated by experts, and subjected to reliability testing. The instrument was also reviewed by the adviser for further improvement. The test was used to determine the mathematics performance of Grade 7 learners before the intervention.

The study focused on Grade 7 Mathematics topics for the fourth quarter, including operations on integers, properties of numbers, exponents, GEMDAS, solving numerical expressions, properties of equality, variables and constants, and solving equations with one unknown. These competencies were aligned with the Department of Education's MATATAG Curriculum.

The intervention involved the use of Math digital games such as Math Missile, Wordwall, and Integer Warp, integrated into lesson plans using the 7E's learning cycle (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend). The intervention was implemented for six weeks during the school year 2025–2026 in a face-to-face learning setup with direct teacher facilitation.

Participants were purposively selected Grade 7 learners from San Dionisio Integrated School, San Rafael, Iloilo. After the intervention, learners were asked to share their learning experiences, which were collected as qualitative data. Quantitative data were analyzed using SPSS with a 0.05 level of significance, while qualitative responses were examined using thematic analysis to identify key themes related to learners' experiences with digital game-based learning.

E. Data Analysis

After the experiment, the data gathered for this study were subjected to appropriate computer-processed statistics employing the Statistics Package for Social Sciences (SPSS) software. The level of significance was 0.05.

Means and standard deviations were used for descriptive statistics, and the Wilcoxon Signed Rank Test was used for inferential statistics.

Furthermore, all qualitative responses were analyzed and subjected through thematic analysis in which participants responses were grouped and summarized into main themes accordingly

VI. RESULTS AND DISCUSSIONS

The findings of the present study are presented in this section.

Table 1

Level of Mathematics performance of Grade 7 Junior High School Learners Prior to Utilization of Digital Games

Category	N	SD	Mean	Description
Pretest	23	4.46	13.04	Low

Note: 0-8.00-Very low; 8.01-16.00-Low; 16.01-24.00-Moderate; 24.01-32.00-High; 32.01-40.00-Very High

Table 1 revealed that Grade 7 Junior High School Learners' Level of Mathematics Performance prior to utilization of digital games was low *(M=13.04, SD=4.46).* This indicates that the participants have low examination performance in Mathematics prior to the intervention as revealed by their pretest scores. The standard deviation was used to ascertain the dispersion of scores from the mean obtained from the different categories in the investigation.

It can be attributed to the fact that while mathematics is the formal study of structure, space, and change, students often perceive it as an intimidating and repetitive discipline. These difficulties frequently arise from the intricate nature of mathematical formulas and the instructional challenge of creating personalized assessments for every learner. However, by approaching math with academic rigor, educators can successfully implement regular, cumulative evaluation methods (Cerbito, 2024).

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Table 2 presents the level mathematics performance of Grade 7 Junior High School learners after utilization of Digital Game.

Table 2

Level of Mathematics Performance of Grade 7 Junior High School learners after Utilization of Digital Games

Category	N	SD	Mean	Description
Entire group	23	6.19	21.74	Moderate

Note: 0-8.00-Very low; 8.01-16.00-Low; 16.01-24.00-Moderate; 24.01-32.00-High; 32.01 40.00-Very High

Table 2 revealed results that the level of Mathematics performance of Grade 7 Junior High School learners was moderate (*M=21.74, SD=6.19*). This indicates that the utilization of Digital Games as integrated in the lesson had improved the Mathematics performance of Grade 7 Junior High School learners as revealed in their posttest scores. The standard deviation suggests the homogeneity of scores after the intervention.

Furthermore, the posttest results of this study supported the idea of Icard (2014) who emphasized that game-based learning represents the most effective method for involving students in the review of course material. Furthermore, establishing an educational environment that fosters both active participation and critical thinking is vital for successful student development.

Table 3 presents the difference in the level of mathematics performance prior to and after utilization of digital games.

Table 3

***Wilcoxon Signed-Rank Test Results on the Difference between the Pretest and Posttest Scores of Grade 7 Junior High School learners** in Mathematics*

Category	Pre-test Mean	Post-test Mean	Sig.(2-tailed)	Z	Remarks
Entire group	13.04	21.74	.000	-3.981[b]	Significant

**p≤ 0.05 level of significance*

Results of the Wilcoxon Signed-Rank Test in Table 3 revealed that Grade 7 Junior High School learners' Mathematics performance prior to and after utilization of digital games was significantly different (p=0.000; Z=-3.981[b]). This indicated that the level of mathematics Performance of Grade 7 Junior High School learners prior to and after utilization of digital games had progressed as a learning intervention done in the study as shown in the pretest and posttest scores of the learners. Data shown that there is a significant difference between pretest and posttest scores imply that the utilization of Digital Games is best alternative to traditional "chalk-and-talk" methods alone. It is perceived those digital games are not just an intervention alone but are rigorous enough to yield measurable academic achievements. It is supported by the study of Icard (2014) who described that the best practice in to engage learners for reviewing the class content was through game-based learning. Moreover, it is very essential for student's learning to create an atmosphere where learners are engaged and think critically.

Themes on Learning Experiences of Grade 7 Junior High School learners on the Utilization of Digital Games.

Table 5 summarizes the five (5) major themes and core ideas based on the qualitative Learning Experiences of Grade 7 Junior High School learners on the Utilization of Math Digital Games

Themes	Core Ideas
Increased Students' Engagement and Enjoyment	However, the digital games acted as a bridge, making complex topic like integers more engaging. The play aspect of digital tools reduces the math anxiety or the perceived difficulty of the lessons.
Overcoming Subject Difficulty Through Gamification	Learners admitted that Mathematics is naturally mabudlay (difficult). However, the digital games acted as a bridge, making complex topic like integers more engaging. The play aspect of digital tools reduces the math anxiety or the perceived difficulty of the lessons.
Collaborative Learning and Peer Support	The use of digital tools in theclassroom encouraged a communal learning environment. Students reported working together (binuligay) to solve problems and succeed in the games. Digital games promoted a social learning environment where higher-performing students helped and mentored others to achieve academic goal such as winning the game or finishing the task.
Incentivized Listening and Extended Learning	The Math digital games served as a reward or a goal. Students expressed a greater willingness to listen to the teachers lecture because they wanted to perform well during the games.
Development of Digital Literacy	the math, but the technology itself. The intervention helped them gain confidence in using technology like laptops.

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VII.CONCLUSIONS AND RECOMMENDATIONS

The analysis of data revealed the following finding

1. The level of Mathematics performance of Grade 7 Junior High School learners was low prior to utilization of digital games as the learning intervention done in the study as revealed in the pretest scores.
2. The level of mathematics performance of Grade 7 Junior High School learners was moderate after utilization of digital games as the learning intervention done in the study as revealed in the posttest scores.
3. There was a significant difference in the level of Mathematics performance of Grade 7 Junior High School learners prior to and after utilization of digital games as learning intervention done in the study as revealed in the pretest and posttest scores of the learners.
4. The utilization of digital games serves as a powerful catalyst in changing learners' attitudes from math anxiety to active engagement. Learners were able to note that while mathematical concepts specifically integers and problem-solving were initially perceived as "mabudlay" (difficult), the interactive nature of the games encouraged persistence among learners. Furthermore, this intervention of the study also triggered a significant social shift in the classroom; the games fostered a culture of "pagbinuligay" (mutual help), where students shifted away from isolated frustration toward collective peer-tutoring and mentoring that led to a collaborative success. This suggests that the digital games did not just teach math skills, but created a more supportive and resilient learning community among the Grade 7 learners of San Dionisio Integrated School.

Conclusions

In view of the preceding findings, the following conclusions were drawn:

1. Junior High School Grade 7 learners have low level of Mathematics Performance. They have not acquired the basic and prior knowledge in learning Grade 7 Mathematics. It can be attributed to the fact that they have gained low Mathematics performance as shown in the pretest scores.
2. Junior High School Grade 7 learners have moderate level of Mathematics performance as shown in their posttest scores. They have improved their learning and acquired the basic and prior knowledge in learning Grade 7 Mathematics and the utilization of digital games further helped improved their level of Mathematics performance. It can be attributed to the fact that they have progressed in their Mathematics performance as evident in their posttest scores.
3. The utilization of Digital Games as integrated in the lesson and as learning intervention done in the study among Grade 7 Junior High School learners significantly improved the learners' Mathematics performance as shown in the differences in their pretest and posttest scores.
4. The utilization of Digital Games enhanced Grade 7 learners' affective and behavioral engagement through the integration of digital games effectively transformed the learners' perception of Mathematics from an intimidating subject into an engaging experience. This change creates a safe learning space or environment that not only upholds academic resilience against complex topics like integers but also incentivizes students to pay focused attention during lessons to succeed in the games.
5. Finally, the intervention done on the utilization of Digital games also led to the promotion of collaborative and peer-driven learning as evident in Grade 7 learners' responses that digital games foster a cooperative learning through pagbinuligay (mutual help), where learners help and engage in spontaneous peer-to-peer mentoring. This collaborative learning atmosphere links the gap between teacher-led instruction and student-led practice, turning individual problem-solving into a collective, holistic and more interactive learning approaches.

Recommendations

Based on the results of the study, the following measures are duly recommended:

1. School administrators should allocate the first two weeks of the first quarter as a bridge program and conduct diagnostic test in Mathematics to assess foundational gaps before proceeding with or introducing Grade 7 Junior High School Mathematics learning competencies. It is suggested that at the start of each grading period, teachers must conduct a diagnostic test focusing on elementary math foundations. This will give the idea whether or not relevant and basic competencies needed are achieved accordingly.
2. Teachers should perceive gamification and utilization of math digital games as a sustained strategy rather than a one-time activity to ensure that "moderate" mathematics performance eventually shift to into higher Mathematics performance. Moreover, it is also highly recommended that teachers should integrate these games into the weekly lesson plan (at least twice a week) to ensure that the learning gains in basic knowledge are reinforced and mastery of the subject matter and/or Mathematics most essential learning competencies are achieved.
3. School administrators including curriculum implementers such a department heads should encourage the formal integration of the utilization of digital games into the daily lesson log or Learning Activity Sheets (LAS) rather than having them only as optional tasks.
4. Educational stakeholders such as teachers and parents should work collaboratively towards the attainment of learning goals. Teachers should utilize reward features of math digital games to motivate students and recognizes students' academic effort and progress not merely focusing on the correct answers. Moreover, parents should have encouragement among school children to utilize and play these Math digital games at home (as seen in Grade 7 learners' responses to allow a sudden shift of screen time to study time.
5. Teachers should consider pairing students with varying mathematical skill levels to maximize the spontaneous mentoring that happens during gameplay. This academic set- up formalizes the pagbinuligay (mutual help) that recurred in participants responses and observed in the study, this is to ensure that spontaneous peer-mentoring transpires to every member of the class, regardless of their initial mathematical skill level. Schools should also explore offline-ready and free versions of these digital tools and

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provide learning facility for learners who lack consistent internet access outside the classroom and those who lack gadgets.

6. Lastly, the results will also be used as basis for future studies involving more respondents such as different grade levels in Junior High School Mathematics for more generalizable results and generate varied learning experiences and implications to academic success.

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