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Utilizing Digitized Game-Based Learning Approach for Students' Interest and Achievement in Grade 7 Mathematics

Grace Pacheco Opada
Cebu Technological University – Moalboal Campus, Moalboal, Cebu, Philippines
grace.pacheco100@deped.gov.ph

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ABSTRACT

This study examined the use of digitized game-based learning activities to support Grade 7 students' interest and mathematics achievement at Demetrio L. Alviola National High School, Bindoy, Negros Oriental, during school year 2025–2026. A quantitative quasi-experimental pretest–posttest design with a survey component involved 120 learners, consisting of 60 in the control group and 60 in the experimental group. The control group received conventional mathematics instruction, while the experimental group participated in a four-week digitized game-based approach. A 48-item competency test, an adapted 20-item mathematics-interest questionnaire, and a learning-style inventory informed data collection. Frequency, percentage, mean percentage scores, descriptive statistics, Wilcoxon tests, and Mann–Whitney U tests were used for analysis. The experimental group's overall mathematics mean percentage score increased from 70.11% to 79.13%, compared with 68.20% to 74.55% in the control group. The experimental group's composite interest rating rose from 3.33 (moderate) to 3.86 (high), with significant pre–post differences reported across all four interest dimensions. However, the between-group difference in learning gains was significant only for the bar-models-and-equations competency ($p = .021$); the other three competencies showed no significant between-group differences. The reported interest–competence association was nonsignificant ($p = .875$). The findings support digitized game-based activities as a supplementary strategy for improving students' mathematics interest, while indicating more limited evidence of advantages in achievement across all targeted competencies.

Keywords: *digitized game-based learning, Grade 7 Mathematics, mathematics interest, academic achievement, algebraic competencies, quasi-experimental design*

INTRODUCTION

Mathematics instruction at the junior high school level challenges learners to move from arithmetic knowledge toward algebraic reasoning, representation, and problem solving. In the Philippines, these difficulties are reflected in national concerns about foundational numeracy and international assessment performance. The Programme for International Student Assessment (PISA) 2022 reported a Philippine mathematics mean score of 355, substantially below the Organisation for Economic Co-operation and Development (OECD) average of 472 (OECD, 2023). The need for engaging, developmentally appropriate ways to strengthen conceptual understanding is therefore evident, particularly as students begin work with variables, equations, and practical algebraic problems.

Digitized game-based learning incorporates curricular learning tasks into interactive challenges, rewards, progressive levels, and immediate feedback. Rather than replacing the teacher or treating gameplay as an end in

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itself, this approach can provide opportunities for repeated practice, peer interaction, and reflection. Reviews of mathematics game-based learning suggest benefits for both cognitive and affective outcomes, although these depend on the alignment of game mechanics, mathematical content, and assessment (Hui & Mahmud, 2023; Pan et al., 2022). Broader research also finds that game-based design and implementation vary substantially across K–12 settings, limiting generalizations about learning gains (Dehghanzadeh et al., 2024).

At the school level, evidence remains needed on whether a classroom-based digitized approach improves learners' measurable algebraic competencies as well as their motivation to learn. The distinction matters because increased enjoyment does not necessarily translate into superior test performance for every topic. The present study investigated Grade 7 students at Demetrio L. Alviola National High School, Negros Oriental, and assessed four Mathematics competencies and four dimensions of learning interest before and after a four-week intervention. It compared achievement gains with conventional instruction, examined the association between interest and competence, and used the findings as a basis for instructional learning activities.

Literature Review

Learning foundations for digitized game-based mathematics

Constructivist perspectives emphasize that learners actively develop understanding through engagement with prior knowledge, new tasks, and social interaction. In mathematics, digital learning games can facilitate the manipulation of representations, testing of strategies, peer discussion, and correction of errors. Chand (2023) described the contributions of Piaget and Vygotsky to learning as active construction and social scaffolding, while Voon and Amran (2021) discussed constructivist applications in mathematics instruction. These perspectives support the use of appropriately sequenced digital challenges instead of passive presentation alone.

Behaviorist reinforcement theory provides a complementary explanation for how rewards and immediate feedback may sustain task engagement. In educational gaming, points, levels, badges, and rapid responses can reinforce persistence and repeated mathematical practice. Nonetheless, reinforcement should serve content mastery rather than simply encourage play. Sailer and Homner (2020) identified effects of gamification across cognitive and motivational learning outcomes, and Dichev and Dicheva (2017) cautioned that outcomes must be interpreted in relation to the design and evidence base of each intervention.

Digitized learning, mathematical achievement, and algebraic competence

Research on game-supported mathematics suggests that instructional design matters. Hui and Mahmud (2023) synthesized evidence for the influence of game-based learning on achievement and affect, while Pan et al. (2022) emphasized the importance of embedding meaningful mathematics within gameplay. Sulpico et al. (2025) reported mathematics outcomes from game-based classroom interventions involving Grade 7 learners, offering contextual relevance for junior high school instruction. Such findings justify testing an intervention across specific competencies rather than treating mathematics achievement as a single undifferentiated outcome.

The four competencies considered in this study involved solving unknowns through bar models and equations; translating verbal descriptions into algebraic forms; solving variables in formulas; and applied problem solving using algebraic expressions and formulas. These require both procedural fluency and conceptual representation. Tepho and Srisawasdi (2023) examined digital games in mathematics performance, while Pilon and Ruales (2024) investigated teacher-made digital games in elementary mathematics. Together, these studies suggest promising instructional possibilities, but their contexts and measured outcomes do not establish that a single approach will yield uniform gains for all algebraic skills.

Students' interest, participation, and confidence in mathematics

Students' engagement can be expressed through enjoyment, perceived relevance, confidence, and classroom participation. These dimensions are distinct but potentially mutually reinforcing: students may take part more willingly when tasks appear worthwhile and attainable. Schukajlow et al. (2023) examined the connections

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between emotion and motivation in mathematics education, while Vankúš (2021) reviewed game-based learning effects on students' affective responses. Consequently, interest should be measured directly instead of inferred only from test scores.

Well-planned digital tasks can make mathematics more approachable through repeated attempts, feedback, collaboration, and visible progress. Alt (2023) considered gameful experience and motivation in mathematics, and Ramli et al. (2020) investigated game-based learning in relation to motivation. However, motivation and competence are not equivalent: a learner can become more engaged without demonstrating an equally large measurable gain over a short intervention period. This distinction is central to the interpretation of the present study's pre–post interest survey and competency tests.

Implementation conditions and Philippine instructional context

The integration of digital games requires access to devices, dependable connectivity, teacher guidance, and alignment with the prescribed curriculum. Classroom approaches must be evaluated in the setting in which they are delivered rather than assumed to transfer unchanged across schools. Akmad and Abatayo (2024) discussed problems associated with unstable internet connectivity and academic access; these issues are pertinent to digitally mediated mathematics tasks and can disrupt the sequence of learning activities and feedback.

Philippine policies encourage learner-centered and developmentally appropriate instruction. Republic Act No. 10533 (2013) provides the national curriculum framework, while Department of Education Order No. 8, s. 2015 addresses classroom assessment and feedback. These frameworks support contextualized, formative, and participatory instructional practices when appropriately implemented. The source thesis situated its framework in constructivist and reinforcement theories, these policy bases, and Sustainable Development Goal 4 (United Nations, 2015). The original conceptual relationships are retained in Figure 1.

Taken together, these strands of scholarship suggest that effective game-based learning depends on two kinds of alignment: the learning activity must target specific mathematical skills, and the game features must meaningfully support interest, feedback, and learner agency. The present thesis addressed both through performance tests in four algebraic areas and a separate four-domain interest measure. This framework enables an evaluation that distinguishes increases in enjoyment and participation from statistically demonstrable differences in achievement (Bai et al., 2020; Pan et al., 2022; Sailer & Homner, 2020).

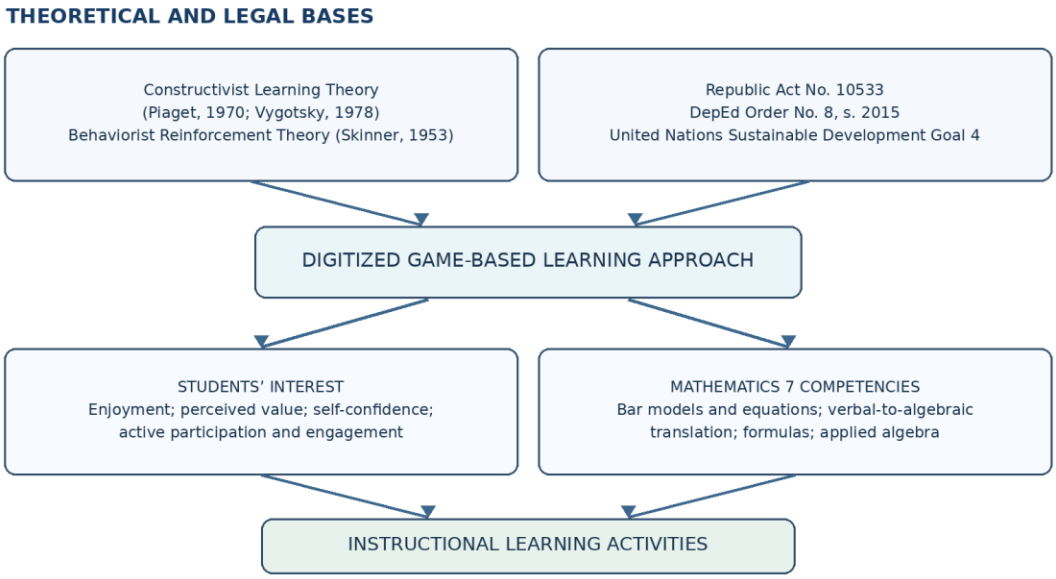


Figure 1. *Theoretical–conceptual framework of the study*

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METHODS

Research Design

The study employed a quantitative quasi-experimental, pretest–posttest control-group design with a survey component. Existing Grade 7 classes were used to compare conventional mathematics instruction and digitized game-based learning. The experimental group completed the digitized activities for four weeks; the control group received traditional instruction over the same instructional period. The research also examined student interest before and after the intervention and the relationship between interest and competence.

Research Locale

The study was conducted at Demetrio L. Alviola National High School, a public secondary school in Bindoy, Negros Oriental, Philippines, during school year 2025–2026. The intervention was implemented within Mathematics 7 classes, using digital presentations, teacher-operated classroom technology, and game-based platforms such as Quizizz, Kahoot! and ClassPoint, as described in the source thesis.

Participants and Sampling Technique

The research included 120 Grade 7 learners selected through intact-class, nonrandom group assignment. Two classes comprising 60 learners formed the control group, and another two classes comprising 60 learners formed the experimental group. Inclusion conditions included enrollment during the stated school year, membership in the identified classes, regular attendance, and parental consent. The two groups were therefore comparable in size, but the design did not involve individual random assignment.

Research Instruments

A 48-item teacher-developed summative test assessed four Grade 7 Mathematics competencies, with 12 items allocated to each. A table of specifications was prepared, and the test was reviewed by a master teacher and approved by the school principal. The experimental group's mathematics interest was assessed using a 20-item five-point Likert questionnaire adapted from studies identified in the thesis (Bai et al., 2020; Dichev & Dicheva, 2017; Sailer & Homner, 2020; Zainuddin et al., 2020). It covered enjoyment and enthusiasm, perceived relevance, self-confidence, and active engagement. A VARK-based questionnaire was also used to describe learning modality preferences (Fleming, 1987).

Data Gathering Procedure

Permissions and parent or guardian consent were obtained before implementing the study. During pre-implementation, participants completed the baseline mathematics assessment and relevant profiling instruments, and the experimental group completed an interest questionnaire. During the four-week intervention, the experimental group participated in digitized learning quests, immediate-feedback tasks, and collaborative challenges, whereas the control group followed traditional lessons. After implementation, the mathematics achievement test was administered again to both groups and the interest survey was repeated in the experimental group. Responses were organized for statistical analysis.

Data Analysis

Frequencies and percentages summarized respondent characteristics, while mean percentage scores (MPS) described competency performance. Means and standard deviations summarized responses to the mathematics interest scale. The study reported nonparametric Wilcoxon tests for within-group pre–post comparisons and Mann–Whitney U tests for between-group comparisons, with the significance threshold set at .05. The thesis also reported a correlation coefficient and associated p-value for the relationship between interest and competence; the latter figures are reproduced as reported and require statistical-output verification.

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Ethical Consideration

The researcher obtained institutional approval and parental consent prior to data collection, briefed learners about participation, and used coded responses to protect identity. The thesis stated that participant confidentiality and secure handling of research records were observed. No personally identifying student records are reproduced in this article.

RESULTS AND DISCUSSION

Respondent profile

The sample included 60 learners in each group, with the largest age category being 13–14 years old (35 respondents, 58.33%, in each group). Female respondents numbered 35 (58.33%) in the control group and 33 (55.00%) in the experimental group. The most commonly reported VARK preference was kinesthetic: 25 (41.67%) in the control group and 18 (30.00%) in the experimental group. Prior Grade 6 mathematics grades differed in distribution, with 27 (45.00%) control-group students in the 85–89 category and 17 (28.33%) experimental-group students in the 80–84 category. These descriptive differences support caution about attributing all between-group performance changes to the intervention.

Table 1. *Selected characteristics of participants by group (n = 60 per group).*

Characteristic	Control, n (%)	Experimental, n (%)
Age 13–14 years	35 (58.33)	35 (58.33)
Female	35 (58.33)	33 (55.00)
Previous Mathematics grade 85–89	27 (45.00)	13 (21.67)
Previous Mathematics grade 80–84	20 (33.33)	17 (28.33)
Kinesthetic learning preference	25 (41.67)	18 (30.00)

Mathematics achievement across four competencies

The control group's overall MPS increased from 68.20% at pretest to 74.55% at posttest, a rise of 6.35 percentage points. In comparison, the experimental group increased from 70.11% to 79.13%, a rise of 9.02 percentage points. These figures indicate descriptive improvements in both groups, with a larger overall change in the digitized game-based learning group. Because the groups began with different pretest levels, the presence and size of a differential intervention effect must be interpreted with the inferential comparisons rather than these descriptive figures alone.

Table 2. *Pretest and posttest mathematics mean percentage scores (MPS).*

Competency	Control pre	Control post	Experimental pre	Experimental post
1. Bar models and equations	66.53	75.00	67.22	80.28
2. Verbal phrases and algebraic forms	69.17	75.28	71.53	81.11
3. Variables in formulas	65.00	71.53	70.00	78.19
4. Algebraic expressions/problems	72.08	76.39	71.67	76.94
Overall MPS	68.20	74.55	70.11	79.13

Within the experimental group, Competencies 1 and 2 reached posttest MPS values of 80.28% and 81.11%, respectively, while Competencies 3 and 4 reached 78.19% and 76.94%. The source thesis attributed improvements to repeated interaction with algebraic tasks and immediate feedback in the digital games. This interpretation is consistent with the instructional mechanisms described in earlier reviews (Pan et al., 2022; Hui & Mahmud, 2023), but it remains an explanation rather than a separate causal test of those mechanisms.

Changes in students' mathematics interest

Students in the experimental group reported an increase in all four interest dimensions. The overall composite mean rose from 3.33 (moderate) before the intervention to 3.86 (high) afterward. Enjoyment and

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enthusiasm increased most in absolute terms, from 3.37 to 4.04, while perceived relevance, self-confidence, and active participation also improved. The findings suggest that digital mathematics tasks can make classroom activities feel more engaging and manageable. The affective gains align with evidence that game-based approaches may enhance learner motivation and participation (Alt, 2023; Vankúš, 2021).

Table 3. *Experimental-group mathematics interest before and after digitized instruction.*

Interest dimension	Before mean (SD)	After mean (SD)	Source interpretation
Enjoyment and enthusiasm	3.37 (0.80)	4.04 (0.68)	Moderate → High
Perceived value and relevance	3.39 (0.79)	3.84 (0.65)	Moderate → High
Self-confidence	3.22 (0.62)	3.85 (0.65)	Moderate → High
Active participation/engagement	3.32 (0.55)	3.71 (0.55)	Moderate → High
Composite	3.33 (0.69)	3.86 (0.63)	Moderate → High

The thesis reported statistically significant pre–post differences across the four interest parameters using Wilcoxon tests, each with a tabulated p-value of 0.000 (conventionally written as $p < .001$). These results support the inference that the learners' survey ratings changed over the intervention period. However, the reported design measured interest within the experimental group and did not separately demonstrate an experimental-versus-control difference in the same interest measures.

For the competency pretest–posttest comparisons, the original thesis also reported statistically significant within-group changes across the four competencies for both control and experimental groups. These within-group tests were presented separately from the between-group mean-gain analysis; significant change over time in each group should not be interpreted as evidence that one group necessarily outperformed the other. Some source descriptions of score medians and MPS do not follow the same direction and merit confirmation from the original test output.

Between-group learning-gain comparisons

The Mann–Whitney U comparison of reported learning gains showed a significant difference only for Competency 1, which focused on equations represented by bar models and solving for unknowns ($p = .021$). The experimental group had a higher mean rank (67.63) than the control group (53.38). Competency 2 ($p = .102$), Competency 3 ($p = .529$), and Competency 4 ($p = .336$) showed no significant differences at the .05 level. Thus, evidence of a between-group advantage was concentrated in the first competency, not generalized across all four measured areas.

Table 4. *Between-group comparisons of reported competency gains.*

Competency	Control rank	Experimental rank	p-value	Result at $\alpha = .05$
1. Bar models and equations	53.38	67.63	.021	Significant
2. Verbal to algebraic	55.48	65.53	.102	Not significant
3. Variables in formulas	58.54	62.46	.529	Not significant
4. Applied algebraic problems	57.57	63.43	.336	Not significant

This competency-specific pattern is important for instructional interpretation. A four-week intervention could support some foundational representation tasks while leaving more complex applications without demonstrable superiority over conventional instruction. The finding is compatible with cautions in the literature concerning variations in learning-game content, duration, and implementation (Dehghanzadeh et al., 2024; Sailer & Homner, 2020). The results do not support a broad claim that all Grade 7 mathematics competencies improved significantly more under the digitized approach.

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Interest–competence association and practical constraints

The thesis reported a very low positive correlation between experimental-group interest and competence ($r = .21$) accompanied by $p = .875$ and classified the relationship as not significant. The reported coefficient and p-value appear inconsistent for a sample of 60, so the original statistical output needs verification. In the absence of a confirmed correction, the article preserves the reported figures and the source's nonsignificant decision; no causal or significant association is inferred from this result.

The source discussion also identified the four-week implementation period and unstable internet connectivity as constraints. Interruptions to digital access could reduce time available for tasks, inhibit immediate feedback, and interrupt learners' focus. Akmad and Abatayo (2024) similarly emphasized the importance of connectivity for learning access. The outcomes therefore suggest that interest gains are promising but must be considered alongside technology reliability, instructional continuity, and the time needed for conceptual mastery.

Table 5. *Interest–competence correlation as reported in the thesis.*

Variables	Reported r	Reported p	Source decision
Mathematics interest and competence	.21	.875	Not significant

Instructional output

The study produced a set of digitized game-based learning activities for Grade 7 algebra content. Its instructional output included teacher-guided digital challenges, quests, badges, collaborative classroom tasks, and practice opportunities matched to the four competencies examined. The output was proposed as a supplementary instructional resource; the study did not provide evidence of its independent long-term effectiveness beyond the intervention period. Its practical value lies in giving teachers structured activities that combine mathematics content, learner participation, and feedback.

The importance of baseline characteristics and instructional duration was recognized in the thesis: earlier mathematics achievement may shape later achievement (Getenet, 2024), and study time is a potential influence on outcomes (Ozyildirim, 2022). The broader gamification literature also reports differences in how games are used and studied (Cayang & Ursabia, 2024; Hwang & Chen, 2022; Rocha et al., 2022).

CONCLUSION

Digitized game-based learning was associated with higher mathematics interest in the participating Grade 7 experimental group and a larger descriptive increase in overall mathematics MPS than that observed under conventional instruction. However, statistically significant between-group learning gains were limited to the bar-models-and-equations competency. The remaining three competencies did not demonstrate significant differences between the control and experimental groups. The thesis also classified the relationship between students' interest and competence as nonsignificant, although the reported correlation statistics require verification. The study therefore provides support for digitized game-based activities as an engaging supplementary approach to Grade 7 mathematics rather than conclusive evidence of a uniform achievement advantage. Its contribution is the integrated assessment of affective and competency-specific outcomes in a Philippine public-school setting.

Recommendation

Mathematics teachers may incorporate appropriately selected digitized quests, feedback-driven exercises, and collaborative games to sustain learner participation while maintaining explicit instruction and assessment of algebraic concepts. Particular attention should be given to Competencies 2–4, for which significant between-group learning-gain differences were not established. School administrators may support teacher preparation, dependable internet or offline-compatible learning resources, and equipment maintenance to reduce interruptions during implementation. Curriculum coordinators may align game tasks with the Grade 7 competencies and use formative assessment evidence to adjust the difficulty and pacing of activities. Future researchers may investigate

longer interventions, assess sustained retention, employ more rigorous group allocation, and independently verify the association of interest with achievement using original statistical datasets before drawing stronger conclusions.

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