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Enhancing the Mathematical Performance of Grade 9 Learners through a Gamified Intervention: The DOD-Elite Game

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ABSTRACT

One of the persistent challenges faced by teachers at Cataingan National High School, Poblacion, Cataingan, Masbate, under the Schools Division of Masbate Province, was the lack of mathematical proficiency among learners. While some students demonstrated strong mathematical abilities, a significant number struggled to attain mastery and efficiency in the subject. Learners' performance in numeracy-based assessments highlighted the need for an innovative intervention. Specifically, Grade 9-Dandelion learners recorded a Mean Percentage Score (MPS) of 66.88% during the third quarter, which placed them under the "Moving Towards Mastery" achievement level. This performance indicated that despite acquiring basic competencies, students had not fully internalized or confidently applied mathematical concepts. The continued reliance on traditional, lecture-based instruction appeared ineffective in addressing the diverse needs of learners. Thus, there was a need for an engaging and innovative teaching strategy to bridge the gap between rote learning and deeper conceptual understanding. In response to this need, the researchers developed and implemented the DOD-Elite Game-an interactive, game-based learning approach designed to promote higher-order thinking skills such as abstraction, decision-making, collaboration, brainstorming, and problem-solving. The game aimed to boost learners' motivation and academic performance in mathematics. The study employed a quantitative pre-experimental one-group pre-test and post-test design. The intervention was conducted over three consecutive days. Each day introduced a unique "lock" challenge, requiring students to solve various mathematical tasks related to the Similarity Theorem and the Pythagorean Theorem. By successfully completing the tasks, students uncovered parts of a three-digit code needed to "unlock" each stage of the game. Learner progress was assessed through pre-test and post-test scores. The results showed an increase in performance, with the mean score rising from 11 in the pretest to 13 in the post-test. Since the data did not follow a normal distribution, the Wilcoxon Signed-Rank Test was used to compare the results. The test yielded a p-value of 0.000002, which was significantly lower than the 0.05 alpha level. This result indicated a statistically significant difference, leading to the rejection of the null hypothesis. The study concluded that the DOD-Elite Game was an effective, engaging, and conceptually rich instructional tool for enhancing mathematical performance among Grade 9 learners. Over the three-day implementation, learners demonstrated measurable improvement in their mathematical understanding and problem-solving abilities. It is recommended that schools facing similar challenges consider adopting gamified instructional strategies, such as the DOD-Elite Game, to improve learner engagement and academic outcomes in mathematics.

Keywords: math proficiency intervention, DOD-Elite Game, abstracted innovation, pretest-posttest design, game-based learning

1. Introduction

Mathematics education in the Philippines played a vital role in shaping students' academic and math proficiency, yet national and international assessments such as TIMSS and PISA have consistently shown that Filipino learners struggled with mathematical concepts. Despite curriculum reforms like the Enhanced Basic Education Act of 2013, which promotes critical thinking and application-based learning, significant gaps remained in problem-solving and numerical foundation.. The UNESCO Education 2030 Framework supported gamification as a promising instructional approach. In response to that support, the "DOD-Elite Game" was developed to address these persistent challenges. Caponetto et al. (2014) noted that game-based learning could enhance student engagement and academic outcomes. This study focused on Grade 9-Dandelion learners at Cataingan National High School, whose 66.88% MPS in Mathematics (Quarter 3) reflected a need for more engaging strategies beyond traditional methods.

The DOD-Elite Game (Do or Die-Elite Game), inspired by the South Korean reality show "Elite League/University War," was designed to integrate mental math and code-cracking elements through die-based gameplay. It promoted perception, calculation, and abstract thinking, fostering a deeper understanding of mathematical concepts. Aligned with DepEd Advisory No. 186, s. 2013 and the educational rights outlined in Article 26 of the UDHR, this research aimed to provide empirical evidence on the effectiveness of gamification in improving math performance. Ultimately, aiming to contribute on the advancement of innovative, student-centered teaching strategies in mathematics.

1.1 Statement of the Problem

This action research examined the effectivity and impact of DOD-Elite Game in enhancing the academic performance in mathematics of Grade 9-Dandelion learners at Cataingan National High School. With the researchers' gamified intervention, specific aspects in math proficiency were identified to be improving significantly. As the intervention seemed unfamiliar to a lot of learners, this would challenge the world of gamification to explore areas that fosters mental math, collaboration, and critical thinking beyond the expected practice. This innovation examined mathematical improvement by incorporating various math related tasks. As the game conveyed flexibility, it is always open for integration beyond the context of mathematics 9. Specifically, the study examined the academic performance level in mathematics of Grade 9-Dandelion learners before and after the implementation of DOD-Elite Game. This study also aimed to determine whether the intervention really improved the academic performance of dandelion learners in mathematics.

2. Methods

2.1 Research Design

This study employed a quantitative pre-test and post-test design to determine the effectiveness of the DOD Elite Game in enhancing the academic performance of Grade 9-Dandelion learners in mathematics at Cataingan National High School. The quantitative approach was chosen to objectively measure learning gains and to provide statistical evidence on the intervention's impact. As emphasized by Creswell (2014), pre-test and post-test designs were effective in identifying cause-and-effect relationships by comparing participants' performance before and after the application of an intervention. In this study, a pre-test focusing on the Similarity Theorem and the Pythagorean Theorem were being administered prior to the implementation of the game-based learning activity. The test, consisting of 15 multiple-choice questions, was developed based on the recommendations of the class's mathematics teacher to ensure alignment with the curriculum. The same number and type of questions were used in the post-test, with slight modification in terms of item arrangement to maintain test integrity while preventing memorization. The DOD Elite Game, which served as the main intervention tool, was introduced and conducted over a three-day period. The game underwent a process of expert validation to ensure that its content and structure effectively supported the targeted learning objectives. Following the gameplay sessions, the post-test was being administered to assess any improvements on learners' mathematical proficiency, including their retention of concepts and ability to apply critical thinking skills. This design and implementation strategy was supported by Vlachopoulos (2017), who highlighted that game-based learning enhanced academic performance and content retention through active engagement and repetitive practice. Overall, the study aimed to generate valuable quantitative data through a structured methodology, offering measurable insights into the educational value of gamified instruction.

2.2 Data Sources

Through purposive sampling, the primary respondents were intentionally selected based on the study's goal of enhancing the academic performance in mathematics. The participants of this study were the Grade 9 Dandelion learners of Cataingan National High School. This section is a regular section 1 class with 44 students. Among them, 42 participated as primary respondents, 32 females and 10 males. This section was chosen not only for its accessibility but also upon the recommendation of the panelist, who noted that although Grade 9 Dandelion learners, as thoughtful as they are, could still benefit from the intervention to further enhance their performance in mathematics. The learners took both pre-test and post-test assessment to measure their math performance before and after the implementation of DOD-Elite Game.

In addition to direct responses, other sources of data included the students' Mean Percentage Score (MPS) prior to the intervention, which was 66.88%, falling under the "Moving Towards Mastery" achievement level. Pre-test and post-test results were gathered to assess improvements in performance after the intervention. These tests focused on topics such as the Similarity Theorem and the Pythagorean Theorem, as suggested by the students' mathematics teacher. Quantitative analysis was also being conducted to determine the effectiveness of DOD-Elite Game that served as an aid in enhancing the academic performance in mathematics. To assess data normality, the Shapiro-Wilk Normality Test was used. Given that the data did not follow a normal distribution, a non-parametric test such as the Wilcoxon Signed-Rank Test was used for valid comparison. Conover (1999) provides a comprehensive overview of nonparametric methods, including the Wilcoxon Signed-Rank Test, highlighting its utility when data do not satisfy the assumptions necessary for parametric tests. This study quantitatively compares gamification and game-based learning, finding that gamification significantly enhances learning achievement and motivation, highlighting the need for quantitative assessments to validate such interventions (Zhang and Yu, 2022). With careful analysis of quantitative data, it was highly possible to confirm the impact of DOD-Elite Game on learners' mathematical performance.

2.3 Research Procedure

To collect the necessary data for this study, quantitative tools were used. These included the previous quarter's Mean Percentage Score (MPS), a Pre-test, and a Post-test. Each tool was carefully chosen to measure different aspects of students' performance during the implementation of the DOD-Elite Game. Additionally, the researchers also secured an approval from the school principal to ensure official permission and support for conducting the research within the school setting (Mertler, 2019).

The first step in gathering data was to obtain a copy of Grade 9-Dandelion's Mean Percentage Score (MPS) from Quarter 3. This score served as basis for evaluating the students' academic performance in mathematics. The MPS of 66.88% indicated that the class was "moving towards mastery," which

supported the need for an intervention. A Pre-test was then administered to the students. This test focused on the Similarity Theorem and the Pythagorean Theorem, based on the suggestions and recommendations of Dandelion's Math Teacher. The test consisted of 15 multiple-choice items. The same number and type of questions were used in the Post-test, with slight modification in terms of its arrangements. These tools helped the researcher assess the students' current level of understanding and later evaluate their progress after the intervention. In terms of validity and reliability, the Pre-test and Post-test were assessed through expert validation.

The DOD-Elite Game, the main intervention of the study, was introduced and implemented over a three-day period. Informed consent ensures that the participants understand the research and voluntarily agree to participate (American Psychological Association, 2020). To understand the game mechanics, students were divided into Team A (Groups 1 and 3) and Team B (Groups 2 and 4), with groupings based on Pre-test scores to mix high and low performers and promote peer learning. Each day, students mentally tracked a die's movement along with 11 unique marks such as X, Y, Z, Triangle, Square, Circle, Dot, Question Mark, Smiley Face, Exclamation, and Star determining how many dots touched the ground at each point without physically rolling it. Tasks were assigned to these marks, with six tasks on Days 1 and 2, and seven tasks on Day 3. To maximize the game complexity, All four groups had three lifelines: "Hint Me" for clues, "Spill the Dot" to check how many dots touched the ground, and "Call for 3D" to use a cube poster for visual aid. Lifelines were limited, requiring careful strategy. The first group in each team to solve all tasks and crack the final code win. Moreover, all groups were rewarded to encourage participation, motivation, and healthy competition. After the game, correct solutions were explained to reinforce concepts and boost understanding, confidence, and performance in math. Expert validation ensures that the game mechanics and learning outcomes are aligned, which is essential for the effectiveness of gamified interventions (Landers, 2014).

Meanwhile, after the gameplay, a Post-test was conducted to determine any improvement in the students' mathematical performance. This was intended to evaluate how well students retained the concepts and applied critical thinking skills after the intervention. With regards to ethical considerations, the researchers safeguarded participants' identities ensuring anonymity and maintaining confidentiality throughout the research process (Creswell & Creswell, 2018). All assessment materials were analyzed and evaluated by the researchers all while maintaining integrity under standardized conditions. The pre-test and post-test data were anonymized before analysis to safeguard participant identities and ensure unbiased processing (Mertler, 2019). Given that the data were not normally distributed, using Wilcoxon Signed-Rank Test is appropriate for valid comparison, to analyze the differences between the pre-test and post-test scores and to examine the effectivity of DOD-Elite Game.

3. Results and Discussion

3.1 Normality Testing of the Gathered Data

The pre-test and post-test data were collected from 42 respondents involved in DOD-Elite Game to test the effectiveness of the intervention that served as an aid in enhancing the academic performance in mathematics. The pre-test being conducted before intervention served as the baseline of learners' knowledge recall, as well as the grouping set-up during the integration. Following the intervention, executing the post-test and analyzing the results is used to evaluate the changes and improvements in academic performance.

The results of the Shapiro-Wilk normality test revealed in Table 1, showed that both the pre-test and post-test data were not normally distributed. Specifically, the W-statistic of Pre-test data is 0.925 and a p-value of 0.0086 while the W-statistic of Post-test data is 0.843 and a p-value of 0.000041. Since both p-values were less than 0.05, following the normal distribution were deemed inappropriate. As a result, a non-parametric test such as the Signed-Rank Test is used as this test does not assume normality. This allowed for a valid comparison of the pre-test and post-test results to assess the effectiveness of DOD-Elite Game on dandelion learners' academic performance in mathematics.

Table 1

Shapiro-Wilk Normality Test Results for Pre-Test and Post-Test Scores of Grade 9-Dandelion

Variables	N	S-W	P-value	Interpretation
Pre-test	42	0.925	0.0086	Not normally distributed
Post-test	42	0.843	0.000041	Not normally distributed

3.2 Academic Performance Level in Mathematics of Grade 9-Dandelion Before and After the Implementation of DOD-Elite Game

The analysis of both the pre-test and post-test mathematical performance of Grade 9-Dandelion learners before and after the intervention of DOD-Elite Game, revealed a significant improvement statistically. The result of Wilcoxon Signed-Rank Test as shown in Table 2 indicated a significant difference between the pre-test and post-test scores (p<0.05). This outcome indicated that DOD-Elite Game had a meaningful impact on students' performance. The p-value being less than 0.05 indicated that the difference between the paired data are unlikely to have occurred by chance, this suggest a real effect, change, or improvement after the intervention.

This research finding aligns with existing research that practicing students to think about their own thinking improves math proficiency. A systematic review by Lomibao et al.(2024) synthesized the effects of gamification in mathematics education within the Philippine context. The analysis revealed that gamification positively impacts student engagement, motivation, academic performance, and higher-order thinking skills. The study emphasized the

importance of interactive and abstracted features in gamified intervention to enhance mathematics learning outcomes. This confirmed the validity of the researcher's post-test results that indicated the effectiveness of DOD-Elite Game as an aid in enhancing the academic performance in mathematics.

Additionally, the data also implied that structured and abstraction-based innovated gameplay such as those of DOD-Elite Game can significantly enhance the academic performance not only on high performing students, Nevertheless, it can also enhance math proficiency of moderate to average performing students in mathematics. Subhash and Cudney (2018) emphasizes that game-based learning or GBL increases motivation and learning outcomes for diverse learners, not limited to high achievers. Given the fact that all 42 learners showed drastic improvements in their post-test scores, this highlighted flexibility and inclusivity of the intervention across diverse learners.

The significant improvement in mathematics performance implicated how evidence based interventions, such as DOD-Elite Game, could promote fresh knowledge-based gaming experience, and reflective and strategic instruction. The researcher encouraged teachers to adopt methods that foster active student engagement, collaboration, and focus on strategy. These adoptable methods not only enhanced math proficiency but also strengthened students' focus and collaborative capabilities in line with Vygotsky (1978) Constructivist Learning Theory that encouraged teachers to use interactive, collaborative, and problem-solving approaches to enhance deep learning.

Reflecting on the success of DOD-Elite Game, it became evident that the intervention reinforced effective gamified learning tools that served as an aid in enhancing academic performance in mathematics among learners. The positive outcomes promoted all the requirements of evidence-based, abstracted, and cognitively-focused intervention. Teachers and Educators are encouraged to explore and adopt such intervention that ultimately not just boosted test scores, but also equipped learners with abstracted fun-gaming experiences, and confidence that are essential in academic growth and future endeavors of learners.

Table 2

Results of the Pre-test and Post-test

Variables	Ν	S-W	P-value	Interpretation
Pre-test – Post-test	42	45.5	0.000002	Statistically Significant

3.3 Intervention Improving the Academic Performance of Grade 9-Dandelion Learners in Mathematics

The analysis of the intervention improving the academic performance of Grade 9-Dandelion learners provided clear evidence that were supported with data above. Statistically, interpretation suggested significant difference given that the p-value is less than 0.05 through Wilcoxon Signed-Rank Test. This finding confirmed that the intervention improved the academic performance of learners in mathematics.

As a result, the null hypothesis that indicated a lacking of significant difference between the pre-test and post-test scores was therefore rejected, while the alternative hypothesis which stated that there is a significant difference between the pre-test and post-test scores are therefore accepted. This statistical findings validated the effectiveness of DOD-Elite Game in enhancing the academic performance in mathematics among Grade 9-Dandelion learners.

4. Conclusion

Based on the thorough analysis of findings, it is evident that the DOD-Elite Game served as an effective intervention in enhancing the academic This action research concludes that the DOD-Elite Game is an effective gamified intervention in enhancing the academic performance of Grade 9-Dandelion learners in mathematics at Cataingan National High School. The quantitative data gathered through pre-test and post-test assessments revealed a statistically significant improvement in students' mathematical proficiency after the implementation of the intervention. The use of the Wilcoxon Signed-Rank Test, a non-parametric alternative due to the non-normal distribution of the data, affirmed that the observed gains were not by chance (p < 0.05). These findings validated the positive impact of the DOD-Elite Game on learners' comprehension and application of mathematical concepts, specifically the Similarity Theorem and the Pythagorean Theorem.

The intervention demonstrated that integrating abstract reasoning, strategic collaboration, and repetitive problem-solving into a gamified structure can significantly enhance content retention, critical thinking, and learner engagement. Supported by previous studies (Lomibao et al., 2024; Subhash & Cudney, 2018; Vlachopoulos, 2017), this research reinforces the growing evidence base that game-based learning (GBL) motivates learners and improves academic performance across diverse learner groups—not only high achievers, but also those performing at moderate or average levels. Furthermore, the DOD-Elite Game's design facilitated equitable participation through group-based, mixed-ability strategies and task-oriented gameplay. The inclusion of lifelines and symbolic game elements supported learners' visual-spatial reasoning and metacognitive skills, aligning with Vygotsky's (1978) Constructivist Learning Theory, which underscores the importance of interactive, collaborative, and student-centered approaches in education.

In light of these results, the study recommends the adoption of gamified instructional tools such as the DOD-Elite Game to promote mathematics mastery, especially in topics requiring spatial abstraction and logical reasoning. The intervention not only enhanced learners' academic outcomes but also fostered motivation, confidence, and enjoyment in mathematics learning. Ultimately, this study affirms that evidence-based, cognitively engaging, and well-structured gamified interventions can serve as powerful tools in transforming traditional mathematics instruction. Educators are encouraged to explore such innovations to make mathematics learning more inclusive, effective, and relevant to the diverse needs of 21st-century learners.

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