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Enhancing the Algebraic Competency Level of Grade 8 Learners Through GAMBLIQUE Game

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A B S T R A C T:

This action research aimed to examine the effectiveness of the GAMBLIQUE Game, a structured game-based intervention, in enhancing the algebraic competency of Grade 8-Narra learners at Cataingan National High School. The study addressed the ongoing challenges students faced in learning algebra, often due to weak foundational knowledge, lack of sufficient practice, and conventional teaching strategies that failed to cater to diverse learner needs. The intervention sought to improve students' understanding and engagement by transforming instruction into an interactive, game-based experience. The GAMBLIQUE Game, inspired by the "Mingle Game" of Squid Game 2, required students to actively participate by forming groups that matched the correct solutions to equations presented by the game master. This dynamic setup combined cognitive problem-solving with social interaction, encouraging learners to think critically under time constraints while collaborating with peers. A quantitative, pre-experimental design was used involving 14 Grade 8-Narra students.

A researcher-made and validated multiple-choice test was administered as a pretest to determine the learners' initial competency in solving linear equations in two variables using substitution. The intervention was conducted over two weeks, with thirty-minute sessions allowing increased time for more complex equations. A posttest was given afterward to assess changes in competency levels. Using the Shapiro-Wilk Test, the data were confirmed to be normally distributed. Paired t-test results showed a statistically significant increase in posttest scores, with a t-value of -6.73 and a p-value of <.001, indicating the effectiveness of the GAMBLIQUE Game in improving learners' algebraic competency. It was concluded that the GAMBLIQUE Game enhanced students' mastery of algebra by fostering motivation, collaboration, and active engagement. The game allowed learners to apply mathematical concepts in an enjoyable yet challenging context. It is recommended that educators integrate similar game-based strategies into math instruction to bridge learning gaps and promote deeper understanding. The intervention not only improved academic performance but also positively influenced learners' attitudes toward mathematics, making it more approachable and meaningful.

Keywords: game-based intervention, algebraic competency level, GAMBLIQUE Game , paired t-test, collaborative learning

Introduction

Learning algebra enhances learners' ability to solve complex problems and figure out solutions in daily life. It teaches students important skills that are not only relevant in academic settings but also in practical situations. Research has shown that students' difficulties in Algebra are often attributed to inadequate foundational knowledge, insufficient practice, and ineffective teaching strategies. Given the MPS and Item Analysis results, it is evident that the current teaching methods may not effectively cater to the diverse learning styles and needs of these students. Negative student attitudes toward algebra can lead to early disengagement from further mathematics study, as MacGregor (2004) stated. Many learners feel stressed and anxious when they have to do math affecting their academic performance (Sokolowski & Ansari, 2017).

To address this challenge, the researchers developed a structured, game-based intervention called "GAMBLIQUE Game" to enhance the students algebraic competency level. The intervention offers a potential solution by transforming the learning experience into an interactive and engaging activity. As stated by Plass et al. (2015), game-based learning improved the students' achievements when learning and supports them to keep engaged and challenged. It is an approach used to stimulate and motivate students to participate actively in the learning process, as supported by Khairuddin and Mailok (2019). This strategy enables teachers to include active learning in their lessons to enhance learners' interest and engagement, therefore the integration of games into teaching and learning is encouraged.

This study examined the effectiveness of GAMBLIQUE Game in enhancing algebraic competency level of Grade 8 learners. By employing games designed to teach specific algebraic concepts and skills, it hypothesize that students will demonstrate improved understanding, increased engagement,and a higher passing rate. The success of the intervention provides valuable insights into effective pedagogical approaches for teaching

algebra and potentially replicated in other schools facing similar challenges. The study was significant because it directly addresses the pressing educational need of Grade 8-Narra learners at Cataingan National High School and offers a potential solution to enhance students' competency levels in Algebra.

1.1 Statement of the Problem

This action research examined the effectiveness of GAMBLIQUE Game in enhancing algebraic competency level of Grade 8-Narra learners at Cataingan National High School. With the implementation of game-based learning, the competency level of learners significantly enhanced. Further, it also examined how the GAMBLIQUE Game supported the competency level by providing an intervention strategy to cater the needs of the learners. Specifically, the study examined the algebraic competency level of Grade 8-Narra learners before and after the implementation of GAMBLIQUE Game. This study also aimed to determine whether the algebraic competency level of learners significantly improved after implementing the said intervention.

Methods

2.1 Research Design

This quantitative study used a pre-experimental design to investigate the effectiveness of GAMBLIQUE Game on the algebraic competency of Grade 8 learners at Catangian National High School. A pre- and post-test measured student learning gains before and after the intervention. The pretest, administered before the intervention, served as a baseline assessment of learners' initial competency in solving linear equations in two variables using substitution (Rinjeni Rakhmawati, 2003). To improve their competency, learners participated in thirty-minute game sessions for two weeks. A post-test, using the same assessment as the pretest, was then administered to evaluate changes in their competency.

2.2 Data Sources

The participants in this study were 14 Grade 8 students from the second-to-last section of Narra at Cataingan National High School, located in the Cataingan West District, Division of Masbate, Philippines. Nine were male and five were female. These learners completed pre- and post-tests to measure their algebraic competency before and after an instructional intervention using a GAMBLIQUE Game.

Researchers conducted a quantitative analysis of pre- and post-test role scores to assess the GAMBLIQUE Game's effectiveness in enhancing algebraic competency level. The Shapiro-Wilk test assessed data normality; since the data were normally distributed, a Paired t-test was used for analysis. Results confirmed that the GAMBLIQUE Game enhanced learners' level of algebraic competency. Data sources included relevant recent literature supporting the analysis and interpretation of findings, such as the mean percentage scores (MPS) of Grade 8 Narra learners in Quarter 3 and item analysis showing their mastery level. The positive effects of game-based intervention on student engagement and motivation in algebra is highlighted, emphasizing how this significantly improved competency levels and higher order thinking skills among learners (Nob et al., 2024).

2.3 Research Procedure

The study involved 14 Grade 8 learners from Section Narra of Cataingan National High School, with 9 male and 5 female learners participating. Ethical considerations were observed, from securing the school principal's approval to ensure official permission and support for conducting the study to obtaining explicit permission from the respondents' parents or guardian. This study employed a quantitative approach, it aimed to determine whether the GAMBLIQUE Game significantly enhanced the algebraic competency level of Grade 8-Narra learners. A researcher-created multiple-choice test, validated by mathematics teachers, served as the primary data collection method. This test was administered as both pre- and post-test to the experimental group, with the pretest given before the intervention to determine their current competency level, while the posttest were given after the intervention to identify the intervention's effectiveness.

During the intervention, learners have allotted time to solve for each equation. As the equation gets complex, the time allotted increases from 60 to 120 to 180 seconds. The pretest and posttest results were carefully analyzed to determine if there is a significant increase to the competency levels of learners. To ensure the data integrity, the researchers used the Shapiro-Wilk Normality Test, a widely used statistical method for assessing whether a data set follows a normal distribution, to verify that the data were normally distributed.

Results and Discussion

3.1 Normality Testing of the Gathered Data

The pretest and posttest data were collected from 14 respondents participating in the GAMBLIQUE Game, to evaluate its efficacy in enhancing algebraic competency. The pretest administered before the intervention served as a baseline assessment of the students' initial competency towards algebra. The posttest administered afterward to evaluate the changes in their algebraic competencies.

Table 1 presents the results of Shapiro-Wilk normality tests for pretest and posttest data. It showed that both the pretest and posttest are normally distributed. Specially, the pretest exhibited a W-statistic of 0.892 and a p-value of 0.087, and the posttest yielded a W-statistic of 0.946 and a p-value of

0.504. Given that both p-values exceeded the significance level of 0.05, the data were normally distributed. As a result, parametric statistical analysis was deemed appropriate.

Table 1
Normality Test of Data

Pretest- Posttest	W-Stat	P-value	Interpretation
Shapiro-Wilk Normality Test	**0.892**	**0.087**	**Normally distributed**
Shapiro-Wilk Normality Test	**0.946**	**0.504**	**Normally distributed**

3.2 Algebraic Competency Level of Grade 8-Narra

Based on Table 2, the algebraic competency level of Grade 8-Narra learners before the intervention reveals a "somewhat competent" grasp across three foundational algebraic skills: solving one variable in terms of another, substituting values to find unknowns, and solving systems of linear equations using substitution. The mean scores of 1.91, 2.18, and 2.36 respectively, reflect moderate proficiency but also highlight existing learning gaps. These results imply that while students may possess a rudimentary understanding of the topics, they likely struggle with conceptual depth and procedural fluency, which are critical for higher-order algebraic thinking. Such limitations can hinder their ability to apply algebraic reasoning in more complex scenarios and real-world problem solving.

This finding draws attention to the importance of implementing pedagogical strategies that foster both engagement and deeper learning. One promising approach is the integration of game-based learning (GBL) into mathematics instruction. GBL offers an interactive and immersive learning environment that promotes active participation, which is particularly beneficial in mastering abstract concepts like algebra (Priyaadarshini et al., 2020). The use of educational games allows students to visualize mathematical relationships, manipulate variables, and receive immediate feedback—all of which enhance understanding. Moreover, according to Li et al. (2021), game-based platforms support the development of problem-solving skills and motivate learners to persevere through challenging tasks, thereby improving overall competency.

From a teaching perspective, the implication is that traditional lecture-based methods may not sufficiently address the learning needs of students at the "somewhat competent" level. Game-based interventions can be designed to specifically target the identified competencies in Table 2. For instance, games that require manipulating equations or applying substitution in interactive scenarios can reinforce algebraic principles in a low-stakes, student-centered manner. As noted by Randel et al. (2019), when learners engage in game-based activities, they exhibit greater retention of content and improved conceptual understanding, particularly when the games are aligned with curriculum standards and learning outcomes.

For learning to be effective and transformative, the integration of interventions such as game-based instruction must be intentional and scaffolded. Teachers must be equipped with the skills to facilitate GBL environments and assess learning in real time. When implemented effectively, such interventions not only close competency gaps but also build learner confidence and autonomy. As researchers like Huang and Soman (2013) suggest, GBL supports diverse learning styles and fosters a positive learning climate, making mathematics more accessible and enjoyable. Consequently, for Grade 8-Narra learners, employing a game-based intervention could bridge the gap between "somewhat competent" and "competent," ultimately enhancing their algebraic proficiency and preparedness for more advanced mathematical challenges.

Table 2
Algebraic Competency Level of Grade 8-Narra Before Intervention

Competency	Mean Score	Verbal Interpretation
Know the concept of solving one variable in terms of the other variable.	**1.91**	**Somewhat Competent**
Substitute the given value of one variable to solve the other variable.	**2.18**	**Somewhat Competent**
Solve system of linear equations in two variables by substitution method	**2.36**	**Somewhat Competent**

3.3 Algebraic Competency Level of Grade 8-Narra Before and After Implementation of GAMBLIQUE Game

The analysis of the pretest and posttest algebraic competency of Grade 8-Narra learners before and after the implementation of GAMBLIQUE Game revealed a statistically significant improvement. As shown in Table 3, the paired sample t-test yielded a t-statistic of -6.73 ($df=13$, $p<.001$), indicating a significant difference between pretest and posttest scores. This suggests the intervention positively and measurably enhanced algebraic competency. The highly significant p-value ($p<.001$) strongly suggests that the observed gains in algebraic competency are attributable to the GAMBLIQUE Game intervention, rather than chance variation.

This finding aligns with existing research emphasizing the efficacy of intervention in enhancing the algebraic competency of learners struggled with solving linear equations in two variables using substitution. Integrating game-based learning can effectively harmonize teachers' and students'

preferences, improving student engagement, coordination, and creativity. This aligns with Wu (2015), who posits that the primary reason for adopting technology-supported learning is to improved student educational outcomes. Furthermore, combining traditional and technology-based approaches, particularly game-based learning, is crucial for increasing student motivation.

The data from this study suggests that the implemented game significantly enhanced learners' competency levels. All participants, initially categorized as "somewhat competent", showed improvement in posttest scores highlighting the intervention's effectiveness. This positive impact on student learning is consistent with the findings of other researchers, even while acknowledging the nuanced perspective of Dinscore (2015), who suggests that while game-based learning may not be inherently superior in educational potential, its ability to significantly enhanced motivation and student interest is undeniable. Conversely, Kucher (2021) and others suggested that students retain knowledge better through game-based approaches than through other methods.

The substantial enhancement in their algebraic competency level demonstrated how evident the GAMBLIQUE Game intervention was, it shows how well learners improved as shown in the result of their posttest. As Boctor (2013) importantly noted that the learning process associated with adventure games can improved learners' general ability to identify solutions to problems.

Additionally, the results highlighted the vital role of game-based learning educational setting. By recognizing the competency levels of learners, educators could design engaging learning experiences. A study of Mozelius & Hettiarachchi (2017), stated games should be designed to ensure that the students can repeat the cycles within the game context without becoming bored. Reflecting om the success of the GAMBLIQUE Game, it became evident that the intervention was as effective teaching strategy in addressing the numeracy gaps among learners. The positive outcomes reinforced students' opportunities and structures to engage more strongly with the education process. The intervention not only boosted the test scores but also equipped learners with strong foundation in solving linear equations that benefits their academic growth.

Table 3
Result of the Pretest and Posttest

Grade 8-Narra	T-statistic	Df	P	Interpretation
Pretest- Posttest	**-6.73**	**13.0**	**<.001**	**Statistically Significant**

4. Conclusion

Studying algebra is vital for enhancing students' critical thinking and problem-solving skills, important in both educational contexts and everyday scenarios. Nevertheless, numerous students face difficulties in algebra because of insufficient foundational knowledge, minimal practice, and conventional teaching approaches that do not accommodate varying learning requirements. The pretest findings of Grade 8-Narra students showed merely a "somewhat competent" grasp of fundamental algebraic principles, highlighting deficiencies in both conceptual comprehension and procedural skill. These difficulties frequently result in decreased confidence, anxiety, and a lack of interest in mathematics, which can obstruct long-term academic development. In response to these challenges, the GAMBLIQUE Game was introduced as a novel intervention designed to enhance learners' algebraic skills via game-based learning. This organized and interactive method changed the learning atmosphere into one that is captivating and collaborative. The notable enhancement seen in the students' posttest results highlighted the game's success in strengthening essential algebraic abilities like equation solving and the use of substitution techniques. By incorporating elements like time-sensitive challenges, repetition, and instant feedback, the game fostered active learning and maintained engagement. Consequently, students grew more driven and better prepared to comprehend and utilize algebraic ideas. The success of the GAMBLIQUE Game underscores its promise as a powerful teaching method, particularly for students who struggle with mathematics. It was not only a tool for assessment; it acted as a means to connect learning gaps and improve classroom involvement. Educators can gain advantages by integrating these interventions into their teaching, as it cultivates an engaging learning environment that promotes enhanced comprehension. This research demonstrates that incorporating educational games into lessons can greatly enhance students' math skills, making algebra easier to understand and more enjoyable. It provides a reproducible framework for fellow educators to tackle comparable challenges in math learning.

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