Effectiveness of Math Legend (Ml) Game-Based Approach in Teaching Mathematics

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.90400214

Received: 30 March 2025; Accepted: 04 April 2025; Published: 06 May 2025

ABSTRACT

Not all students like learning Mathematics. Some sees it as a boring and a burden subject. This factor contributes to the decreasing mean percentage score of the quarterly exam result. That is why, this study is realized, it is about an approach in teaching Mathematics that aims to know the significant difference in math performance between the Control and Experimental Groups of participants and when group according to their mathematical abilities; the significant interaction effect between the control and experimental groups and when group according to their mathematical abilities; and propose an intervention program based from the results of the study. The data gathered proved that both methods showed effectiveness to the both groups. On the other hand, above average in both methods failed to reject null hypothesis. These proves that that there is no effect in the said level and also in the below average level. In contrast, the data in the average level has difference in both methods. Thus, it implies that there is a significant difference in Math performance between control and experimental groups of students. It is therefore found out that the academic achievement of the between the Control and Experimental Groups of participants and when group according to their mathematical abilities has a significant difference. And there is no significant interaction effect between the control and experimental groups and when group according to their mathematical abilities. These concludes that students learning depends on them. There learning was not really impacted by the strategy used. Students learn in different situation may it a student-centered approach or the teacher-centered approach. Learning happens anytime and anywhere. They get more interested when they are involved and engage. It also makes them feel excited to be part of the game not realizing the importance of the game being an integration.

INTRODUCTION

Mathematics is full of surprises that can be interesting and fun. It is known as cold, logical, and rigorous, but the subject doesn't get enough credit for its true mischievous spirit, which is well-hidden from the world. The K–12 mathematics curricula can involve time and space to play with concepts and ideas, even in the rush of required topics (Oldridge, 2019). This curriculum aimed to make the learners holistically developed the 21st century skills which includes critical thinking, communication, collaboration, creativity, digital literacy, and problem-solving. Critical thinking and problem-solving skills encompass Mathematics concepts. Teachers play a crucial part to make it attained and observable to the learners. The researcher thought, planned and wanted to implement a game-based approach in teaching. This study will utilize some of the concept of the Mobile Legend game to make it interesting and interactive to most of the student since this game is one of the trends in this generation.

According to Kamarudin et al. (2019), the level of student interest in teaching and learning is low when the conventional approach is employed. Consequently, teaching methods and techniques are essential for becoming a teacher who can impart knowledge to their pupils using a variety of engaging approaches and strategies. Game-based learning is a mathematics teaching technique that creates a balance between classroom learning and educational games while enhancing the learning efficiency through student-centered learning activities (Lasut and Bawengan, 2020). Additionally, educational games may encourage the students to enjoy learning, to feel comfortable approaching a variety of difficulties along the way, and to overcome these challenges with focus, self-assurance, and patience, all of which are crucial for higher education in the development of lifelong learners (Liu et al., 2021). By introducing gaming elements as a training method, game-based learning platforms will boost students' engagement, motivation, and productivity. Game-based learning is more than just making games

for students to play on the surface; it is also about establishing learning activities that gradually teach subjects and lead users to achieve goals (Ismaizam, et al., 2022).

On the conduct of the First Quarter Examination last school year 2023-2024, specifically in Grade 10, the data revealed a low Mean Percentage Score. The test composed of all the topic covered in the first quarter. The mean percentage score is 56.59. The result is alarming. The observations gained by the researcher used as a tool for the decision on the activities conducted. To motivate students, the teacher initiates in integrating the wide spread online game, Mobile Legend, as a game-based approach in assessing students grouped in Warrior (Level 1), Elite (Level 2), and Master (Level 3). This helped the teacher identify students' level of learning and for the students to motivate learning. Attention of the students will be taken because of the integration of game. This study creates a strong rapport between the teacher, students, and the activities that will be employed. This study has a great contribution to the teacher in assessing students learning and in attaining the learning objectives of the lesson. The mathematical abilities of the students were easily identified by the teacher and also the student. Students are interested in the game. After the lesson, they were excited for the next day's activity. Students speed in solving problems were also developed and enhanced. With this study, students will surely love Mathematics. In this study, discussion was employed and examples answered by the students in a form of a game was done. They were given game cards. They answered the questions in each level in a given time. After answering, they show their solution and answer to the teacher. The teacher marks the error area, with this student corrected the mistakes. A constructed answer was then shown. On the next level, they were able to apply the learnings and faced the next difficult level. Specifically, it sought to answer the following questions: What is the pretest and posttest mean scores of the students both in Control and Experimental Groups? Is there a significant difference in math performance between the Control and Experimental Groups of participants and when group according to their mathematical abilities? Is there a significant interaction effect between the control and experimental groups and when group according to their mathematical abilities? What instructional material can be proposed based from the result of the study?

Theoretical/Conceptual Framework

In today's generation, students' mathematical skills are alarming. Some of the teachers' reasons are the allotted time in the teaching-learning process and the students' lack of interest in learning the subject. This sometimes lead the teacher to not integrate game during teaching-learning process, while some integrate a game that can be employ in a short time. The study anchored on the Constructivist Theory of Jean Piaget. A theory based around the idea that learners are active participants in their learning journey; knowledge is constructed based on experiences. As events occur, each person reflects on their experience and incorporates the new ideas with their prior knowledge. Learners develop schemas to organize acquired knowledge. This is vital to understanding how students learn. The idea that students actively construct knowledge is central to constructivism. Students add (or build) their new experiences on top of their current foundation of understanding (Kurt, S., 2021). This study is also supported by Self-Determination Theory. A theory of human motivation where individuals are viewed as proactive (Ryan & Deci, 2019). The meta-theory overseeing SDT is that all human beings are born with tendencies toward growing, mastering challenges, and integrating new experiences in a volitional manner. Self-determination theory suggests that people can become self-determined when their needs for competence, connection, and autonomy are fulfilled (Cherry, K., 2022). Competitiveness in serious games and game-based learning contexts, have been suggested to be associated with variations in flow experience pertaining from game experience. Evidence from the game-based learning literature suggested that game-based learning in general enhances learning outcomes (Chan et al., 2021). Such enhancement on learning has been reviewed and suggested that game-based learning enhances learning performance and outcomes through affective (e.g., enjoyment), cognitive (e.g., cognitive load), and behavioral (e.g., intention to participate in learning) mechanisms (Koivisto and Hamari, 2019; Sailer and Homner, 2019). The daily lives of high school students are filled with constant feedback through social media sites, massive online gaming, PC games and instant access to information through the Web. Gamification is the bringing of game elements, into non-gaming environments to capture the motivational factors found in games (Fulton, 2019). In eight years, the number of researches connecting learning, and motivation has significantly increased, illustrating the interest and possibilities of what gamification.

RESEARCH METHODOLOGY

This study used Quasi-Experimental Design to determine the effectiveness of Math Legend (ML) Game-based Approach in first quarter learning competencies on grade 10 students. A quasi-experimental design is a study design in which participants cannot be randomly assigned to an experimental or control group for practical or ethical reasons (Sreekumar, D., 2024). This design measured the dependent variable at a subsequent time. The dependent variable in this study were the level of learning of the students. The independent variable which were two methods that were used in teaching, these were expected to have an effect on the learning of the students. The researcher will utilize fishbowl technique in choosing the respondents.

This study covered the effectiveness of Math Legend (ML) game-based approach in the discussion of the different topics for the first quarter in Mathematics of grade 10 students of Solomon P. Lozada National High School, Amag, Bayabas, Surigao del Sur for the school year 2024 – 2025. It was conducted to the students under the regular class of the said school with a total population of 60 students out of 160 population of Grade 10 students. It focuses on the effectiveness of the game. The study was conducted within the First Quarter which covers the lessons for a reason that the lessons are very appropriate in this game. There are ten (10) lessons in this quarter, such as: Generating Patterns; Arithmetic Sequence; Arithmetic Means; Sum of the Terms of a Given Arithmetic Sequence; The nth Term of an Arithmetic Sequence; The nth Term of the Geometric Sequence; Geometric Series; Geometric Means; Performs Division of Polynomials Using Long Division and Synthetic Division; and Proves the Remainder Theorem, Factor Theorem and the Rational Root Theorem. The subjects of the study were the Grade 10 students of Solomon P. Lozada National High School enrolled in the School Year 2024-2025. There are three (3) sections in this grade level and a population of one hundred eighteen (118) of these are Grade 10 students. This study will include two sections. All learners of the class will serve as the respondents. Table 1 presents the distribution of respondents.

This study utilized the Surigao del Sur Division unified tests questionnaire. The questionnaire was developed and quality assured by the experts and specialists in Mathematics of the said division. It is composed of 50 items multiple choice test anchored to the Most Essential Learning Competencies of Mathematics 10 and level of questioning was based on the Revised Bloom's Taxonomy of Benjamin Bloom. Pretest was conducted before the discussion. During the discussion, the teacher will employ a game, a Math Legend game. It consists of three (3) levels. The levels or rank in the online game, Mobile Legend, was used namely Warrior, Elite, and Master. Warrior served as the easy level, Elite as the average level, and master as the difficult level. The student scored the highest rank got the highest point. The students proceeded to the next rank when they answered all problems in a certain rank correctly. After the conduct of the game, a posttest will be conducted. The researcher used the Mean to get the mean scores of students in pre-test and post-test of the two methods, One-Way ANOVA to identify if there is a significant difference between the mean gain score of the students in the pre-test and post-test using the conventional and experimental methods, Two-Way ANOVA to identify if there is a significant interaction effect between the control and experimental groups and when group according to their mathematical abilities, ANCOVA used to compare one variable in two or more populations while considering other variables on the effectiveness of the game-based approach in the first quarter learning competencies.

RESULTS AND DISCUSSIONS

The pretest and posttest mean scores of the participants both in Control and Experimental Groups

Table 2. Students' Mean scores in the Pretest and Posttest

Type		N	Pre-test		Post-test	
			Mean	Std Dev	Mean	Std Dev
Control	Above Average	22	14.591	3.018	20.5	5.74
	Average	6	16.33	1.633	22.83	4.62

	Below Average	2	20	7.07	31.5	0.707
Experimental	Above Average	22	12.273	3.396	21.955	4.1
	Average	6	14.5	3.56	26.5	2.74
	Below Average	2	15	2.83	31.5	0.707

Mean refers to the average value of a group of numbers. Adding all the figures, divide by the number of values. On the other hand, standard deviation provides insight into how much variation there is within a group of values. It measures the deviation (difference) from the group's mean (Sykes L.M. et al.,2019). The table revealed the mean scores of students in the pre-test and post-test both in the control and experimental groups. The pre-test results implied that the students (both subjected in the control and experimental methods of instruction) had a little prior knowledge and understanding of the topics in the first quarter. The students in the controlled group had a mean gained score of 16.97 for the pre-test and 24.94 in the post-test. The result showed that the scores from pre-test to post-test increased. While the students in the experimental group obtained a pre-test mean score of 13.92 and post-test mean score of 26.65. The result showed that the scores of the students from the pre-test doubled their scores in the post-test. The results proved that integrating topics into game gave more impact on the learners' understanding than the traditional way of teaching. Hung et al. (2020) posited that the incorporation of games as a novel pedagogical tool or approach in education has emerged as a means to enhance the academic achievement of educators. On the same side, Ramirez (2019) emphasizes that, "learning is good when it provides learning experiences or situations that will ensure understanding. Good teaching requires a rich environment, instructional materials and devices. Materials and devices challenge the attention of the learner, simulate thinking and facilitate understanding to make learning more meaningful."

The significant difference in math performance between the Control and Experimental Groups of participants and when group according to their mathematical abilities

The table below represents the significant difference in math performance between the Control and Experimental Groups of participants and when group according to their mathematical abilities.

Table 3. Significant Difference in Math Performance between the Control and Experimental Groups of participants and when group according to their Mathematical Abilities

Source of Variation		t-value	P-value	Decision	Conclusion
Experimental Group	Below Average	9.53	0.000	Reject Null Hypothesis	Highly Significant
	Average	8.22	0.000	Reject Null Hypothesis	Highly Significant
	Above Average	6.60	0.096	Failed to Reject Null Hypothesis	Not Significant
Control Group	Below Average	4.26	0.000	Reject Null Hypothesis	Highly Significant
	Average	2.84	0.036	Reject Null Hypothesis	Highly Significant
	Above Average	2.09	0.284	Failed to Reject Null Hypothesis	Not Significant

The table 3 shows the result of the significant difference in math performance between the Control and Experimental Groups of subjects and when group according to their mathematical abilities. Based on the table above, at 0.05 significance level shows that both methods in the below average and average level reject the null hypothesis since it has p-values less than 0.05. The data proves that both methods showed effectiveness to the both groups. On the other hand, above average in both methods failed to reject null hypothesis. These proves that that there is no effect in the said level. Thus, it implies that there is a significant difference in Math performance between control and experimental groups of students. According to Ganyaupfu (2019), learning is a process that involves investigating, formulating, reasoning and using appropriate strategies to solve problems,

teachers should realise that it becomes more effective if the students are tasked to perform rather than just asked to remember some information. A typical learning environment with a presentation from the course teacher accompanied by a lecture neither promotes learners' participation nor build the required level of reasoning among students. Students build a better understanding of the main concepts more effectively when they are engaged to solve problems during class activities.

The significant interaction effect between the control and experimental groups and when group according to their mathematical abilities

Table 4. Interaction effect between the control and experimental groups and when group according to their mathematical abilities

Source of Variation	F-value	P-value	Decision	Conclusion
Factor A (Pretest Posttest)	0.836	0.365	Failed to Reject Null Hypothesis	Not Significant
Factor B (Mental Ability)	10.235	0.000	Reject Null Hypothesis	Highly Significant
Factor A * Factor B	0.341	0.713	Failed to Reject Null Hypothesis	Not Significant (No Interaction Effect)

At 0.05 level of significance, observed that table above shows that Level has a p-value of 0.365 which is greater than 0.05 and the decision is failed to reject the null hypothesis. It indicates that there is no significant interaction effect between the control and experimental groups and when group according to their mathematical abilities. The method has a p-value of 0.000 which is less than 0.05 and the decision is to reject the null hypothesis. It indicates that there is significant difference in Math performance between the Control and Experimental Groups of participants and when group according to their mental abilities. Therefore, students learn more when the lesson is integrated with a game. They tend to interact more when each of them is involve and part of the game. Learning in their mistakes is more effective and meaningful. The table 4 also depicted that interaction effect has a p-value of 0.713 which is greater than 0.05 and the decision is failed to reject the null hypothesis. Therefore, it concludes that there is no significant interaction effect between the control and experimental groups and when group according to their mathematical abilities. This result implies that each student has different interest, most of the students learn through engaging themselves in a situation, but there are also students learn by just observing and learning through others experience. These observations truly aligned to the individuals learning style whether teachers use a student-centered strategy or not. Students' level is not the same. There are students who has a higher level of understanding in which it finds them boring interacting into lower-level activities. Learning environments in which students are viewed as individuals as well as teaching built on their personal values foster learning in mathematics. For meaningful learning to take place the new mathematical content to be learned must be connected to the personal conceptual frame of reference and values adopted by the student. Thus, learning environments in which students are viewed as individuals improves learning outcomes. In particular, teaching that is built on the interests of students seems to have a positive impact on their motivation and learning. It could be concluded from the studies that deeper consideration of the student's personal thinking and world values will assume more importance in the future. Meaningful learning is a personal process, which can be supported by teacher guidance and a favorable learning environment (Koskinen, R. 2022).

CONCLUSION

The students in the control group has a mean score of 16.97 for the pre-test and 24.94 in the post-test. The result showed that the scores from pre-test to post-test increased. While the students in the experimental group obtained a pre-test mean score of 13.92 and post-test mean gained score of 26.65. The result showed that the scores of the students from the pre-test doubled their scores in the post-test. The results inferred that integrating topics into game gave more impact on the learners' understanding than the traditional way of teaching. The mean score of the students who belong to above average level in Experimental Method got 12.273 in pre-test and 21.955 in post-test for an overall mean score of 17.11. In the average level, the mean score in pre-test is 14.5 and 26.5 in the post-test, then the overall mean score is 20.5. On the other hand, the students in below average level got a

mean score in pre-test of 15 and 31.5 in post-test for an overall mean score of 23.25. In the Conventional Method, the mean score of the students who belong to above average level is 14.591 in pre-test and 20.5 in post-test for an overall mean score of 17.55. In the average level, the mean score in pre-test is 16.33 and 22.83 in the post-test, then the overall mean score is 19.58. On the other hand, the students in below average level got a mean score in pre-test of 20 and 31.5 in post-test for an overall mean score of 25.75. The data gathered proved that both methods showed effectiveness to the both groups. On the other hand, above average in both methods failed to reject null hypothesis. These proves that that there is no effect in the said level and also in the below average level. In contrast, the data in the average level has difference in both methods. Thus, it implies that there is a significant difference in Math performance between control and experimental groups of students. It is therefore found out that the academic achievement of the between the Control and Experimental Groups of participants and when group according to their mathematical abilities has a significant difference. And there is no significant interaction effect between the control and experimental groups and when group according to their mathematical abilities. Integrating games in the class really affects students learning. The game should be appropriate to the level of the students. Teacher can give contextualized activity in the game so that low performing students improved their learning and understanding, and for the high performing students, teacher incorporate a higher order skill activity to the student that encompasses the lesson.

The performance of the students in the experimental group is higher than the controlled group. The mean scores of the students from the pre-test doubled their scores in the post-test. This implied that the game integrated was very useful in the improvement to each of the students. The two teaching strategies showed effectiveness to the students in learning. It implies that the experimental and conventional method was delivered appropriate to the level of the students. All levels of students improved their ability. Students in the average level has a greater improvement. From the two methods, the three levels on the experimental group was higher than controlled group. These concludes that students learning depends on them. There learning was not really impacted by the strategy used. Students learn in different situation may it a student-centered approach or the teacher-centered approach. Learning happens anytime and anywhere. They get more interested when they are involved and engage. It also makes them feel excited to be part of the game not realizing the importance of the game being integrated. Giving time limit in answering a problem was also a way to boost interest and motivation to the students.

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