GAME-BASED LEARNING AS A TEACHING STRATEGY IN IMPROVING THE STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS 8

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ABSTRACT

This study's primary goal was to gain insight into how using a game-based learning technique as opposed to the traditional method as a teaching strategy influenced student achievement. Two modules, the Rational Expressions and the Rectangular Coordinate System, and their related set of questionnaires were used to compare two groups, the control group and the experimental group. The experimental group, who received the intervention, was taught using a game-based learning strategy, whereas the control group was instructed using a more traditional teaching style that included seatwork, discussion, and lectures. Before and after each module was discussed to the control and experimental groups, pretests and posttests were given, and the results were compared as an indication of the students' progress. According to the study's results, there was a significant difference between the experimental group's pretest and posttest achievement levels for the students. Additionally, there was a significant difference between the students' posttest achievement levels of the experimental and control groups. Thus, it proved that the students' learning was improved by the application of game-based learning. We can draw the conclusion that in teaching Grade 8 mathematics, game-based learning performed better than the traditional method. The researcher's recommendation to schools to employ game-based learning was prompted by the experiment's encouraging outcomes.

Keyword: *game-based learning, traditional method of teaching, achievement level, teaching strategy*

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1. INTRODUCTION

Over the last thirty years, teaching methodology has come to be recognized as one of the most important aspects of the teaching-learning process. It served as a gauge for academic progress. Students' performance on high-stakes achievement tests continues to be low even when measures like teacher professional development are put in place. It suggests that instructors' professional development and standard curriculum are not the only factors that contribute to students' academic growth; teaching strategies employed during the learning-teaching process also play a significant role (Rondina & Roble, 2019).

In a study by Azmidar et al. (2017) in Jerman, they mentioned that elementary and middle school kids' interest in studying is declining year over year, particularly in mathematics and other sciences. Less than 9% of high school students said they enjoyed their math classes, and very few or practically none of them were interested in studying math courses in college. Likewise, a study by Boldadora (2018) conducted in Davao City, Philippines, examined the impact of digital game-based learning on students' math proficiency in which the findings suggest that digital game-based learning can aid students in raising their mathematical proficiency, particularly in numbers.

Games in this context are defined as games which are deliberately contrived with the sole purpose of exploiting them as educational tools. Games have been characterized as being very stimulating in terms of how long players play for and how well they maintain attention (De Freitas, 2006). As Bonk and Dennen (2005, as cited in De Freitas, 2006) stated that games are motivating in part because of their unpredictable outcomes and the emphasis they place on a task or challenge that the player must complete; games provide a special chance to evaluate the learning of students, and that critical thinking and problem-solving skills of students are assessable by noting students while playing games and by examining performance information, an evaluation method called "stealth assessment" (Kaya ,2010, as cited in Pho and Dinscore, 2015).

On the other hand, game-based learning is a sort of gameplay with predetermined learning objectives. In general, game-based learning is created to strike a balance between content and gameplay, as well as the player's capacity to remember and use the content in the real world. Pivec et al. (2003) stated that several aspects of the learning process are supported and facilitated by the use of computer games and games in general for educational purposes because it provides a diversity of knowledge presentations and opportunities to apply the knowledge in a virtual world.

Researchers' attention has recently been drawn to the creation and use of games in the curriculum of schools and courses. There has been considerable interest in using games as educational tools to support students' learning and teachers' teaching techniques in recent years, with a particular focus on the integration of digital technology and games in education (Wu et al., 2012 as cited in Grivokostopoulou et al., 2016). Educational games have been shown to improve student engagement, motivation, and learning by making it more individualized and adaptive (Hamdaoui et al., 2021). Teachers are creating and using more serious games and educational software in the context of their classes. Grivokostopoulou et al. (2016) added that tutors, educational institutions, and researchers have recently become highly interested in the creation and adoption of computer games and game-based learning methodologies in educational procedures.

Game-based learning was born out of game research in the middle of the 1950s, and since the 1980s, academics have been studying and using game-based learning in instruction (Pan et al., 2021). Game-based learning has a long history too, as any other concepts, ideas, principles and theories in the field of education have. As Hellerstedt and Mozelius (2019) conducted a study concerning the history of game-based learning, they alluded that several studies on game-based learning are restricted to digital learning games and begin in the Tetris and PacMan period, and that the game-based learning idea has a lengthy antecedent with using board games like Kalaha, Xiangxi, Chess, and other types of games, developing strategic and tactical thinking in educational settings, as well as capabilities in language, arithmetic, and other topics, for hundreds of years.

The styles of teaching in a classroom have been changing, modified, and improved, according to the styles individual student best learns from. One of these styles is called traditional method of teaching, which also known as conventional education. Traditional method of instruction is a planned educational program that emphasizes direct instruction by teachers, including teacher-led discussions and the sharing of instructor knowledge with pupils, and individual written assignments, lectures, and textbooks serve as the foundation for instructional materials (Staker & Horn, 2012). Tularam and Machisella (2018) mentioned that the majority of traditional teaching methods are teacher-directed, where pupils are instructed in a position that encourages listening while they are sitting, and that it is frequently stated that these methods may not teach pupils important learning techniques, and non-traditional methods of instruction and learning could better equip pupils with these abilities.

The teacher is viewed as the heart of the classroom in the conventional style of instruction, in charge of all activities, and in charge of making sure that all messages are given to pupils, either directly via him or through the deductive method of instruction. In this, the instructor continues to be more subjective, dynamic, and less emotional (Singh, 2004). Rao (2001) added that conventional methods primarily ignore higher levels of rational outcomes in

favor of reviewing true facts. Also, Weber (2006) supplemented that traditional educational methods conflict with how the human mind normally functions; and the interests and consideration of students cannot be taken into account throughout the lengthy traditional teaching hours (Cangelosi, 2003).

According to some academics, using technology in the classroom can improve students' learning. Twenty years of research have demonstrated that learning with multimedia enhancement results in at least 30% more learning in 40% less time and at 30% lower cost. Retention increases to 80% when a multimedia presentation is used for multimedia methods of instruction, compared to 40% for discussion techniques or 20% for the conventional lecture approach with visual aids (White and Kuhn, 1997, as cited in Ogochukwu, 2010). Arcagok (2021) supported that when compared to traditional methods, game-based teaching techniques are used in various curricula and have a good impact on students' academic progress.

As Noreen and Rana (2019) stated, because it has been demonstrated that the more the senses are stimulated, the more a person learns and the longer he or she retains, learning by doing is crucial to successful understanding. The learners become more intelligent and energetic to activities. Because we are aware that education leads to a child's overall progress, we must plan a variety of activities to develop the learners' personalities in different ways. For the students, the activity-based instruction style serves as a dynamic problem solver. It enhances the inventive aspect of the experience and provides learning context. It offers the students a range of experiences to promote the acquisition of knowledge, experience, abilities, and traits. It increases students' self-assurance and fosters learning via works. For them, it fosters a positive bond and passion. When a youngster has the freedom to research on his own and is provided with the best learning environment, learning becomes fun and lasting. It motivates students to use their creative thinking, knowledge, and minds to solve issues. The kid is the primary emphasis of activity-based learning teaching, or we could say that it is one of the child-focused approaches. It cultivates in students a capacity for self-learning and enables each student to progress at their own pace. It has been seen that activity-based learning activities enhance students' academic performance and attitudes toward activities, as Çelik (2018) writes.

1.1 Theoretical Framework

This study was supported by the Flow Theory of Mihaly Csikszentmihalyi (1975). According to flow theory, when students are in a state of flow, they are so immersed in what they are doing that they are unaware of the passing of time and are not interested in anything else. While one is in this flow state of mind, self-consciousness can disappear and one's perception of time can change (Csikszentmihalyi, 1991, as cited in Vann & Tawfik, 2020).

The goal of flow theory is to comprehend how and why people feel when they are having the most fun (Biasutti, 2017). A mental state known as "flow" combines cognitive, physiological, and affective components. Flow refers to a state of deep engrossment in an enjoyable activity, such as when artists or sportsmen are concentrated on their play or performance (Csikszentmihalyi, 1990, as cited in Admiraal et al, 2011). In game study, this state in which players are focusing and losing themselves in contemplation, it is frequently explained using the flow theory (Bakan & Bakan, 2018).

1.2 Statement of the Problems

This research specifically aimed to respond to the following queries:
1. What is the level of competency of the students in pretest scores?
2. What is the level of competency of the students in posttest scores?
3. Is there a significant difference between mean pretest scores of the students in control group and experimental group?
4. Is there a significant difference between the pretest and posttest mean scores of the control group?
5. Is there a significant difference between the pretest and posttest mean scores of the experimental group?
6. Is there a significant difference between mean posttest scores of the students in control group and experimental group?

1.3 Null Hypotheses
The following hypotheses were developed in order to fully and accurately address the problems:

Ho1:   There is no significant difference between the pretest mean scores of the students in control group and the experimental group.

Ho2:   There is no significant difference between the mean scores of the pretest and posttest mean scores of the students in control group.

Ho3:   There is no significant difference between the mean scores of the pretest and posttest mean scores of the students in the experimental group.

Ho4:   There is no significant difference between the posttest mean scores of the students in control group and the experimental group.

1.4 Definition of Terms

Academic Performance. This term refers to the results of the pretests and posttests of the students who are subject for the study.

Control Group. This term refers to the group of students to whom the traditional method of teaching will be employed as the teaching strategy in Grade 8 Mathematics.

Experimental Group. This term refers to the group of students to whom the game-based learning will be employed as the teaching strategy in Grade 8 Mathematics.

Games. This term refers to the games which have a clear educational focus, as well as those with helping or secondary educational value. Examples include card games, board games, and video games.

Game-based Learning. This term refers to the active learning strategy that combines game components with the learning environment and employs techniques that are often used in games to promote and improve learning, practice, and assessment.

Traditional Method of Teaching. This term refers to the teaching strategy which is teacher-centered that upholds the teacher's dominance in the classroom environment, in which students learn by means of repetition and memorization.

2. METHODS

2.1 Research Design

This study made use of the quantitative research specifically the Pretest-Posttest controlled experimental design. Greater knowledge and comprehension of the social world are the goals of quantitative research. To examine situations or events that have an impact on people, researchers utilize quantitative methodologies. Quantitative research generates unbiased data that can be explained in detail using statistics and figures (Williams, 2021). Experimental research design is the technique of doing research in a methodical, controlled manner which ensures that accuracy is maximized and that particular inferences can be made with relation to a hypothesis (Bell, 2009). Moreover, experimental research design is utilized when the objective of the study is to determine the impact a factor or independent variable has on a dependent variable.

2.2 Research Respondents

The respondents of the study were the Grade 8 Junior High School students of the Assumption Academy of Monkayo, Inc., Monkayo, Davao De Oro, for the school year 2022–2023. There were two sections of the aforementioned grade level, namely: St. Dominic and St. Jude.

Given that they regard mathematics to be a tough and challenging subject in general, most of the students in the two aforesaid sections are eager to master it. Moreover, the researcher had observed that these students were fond of playing games of any sort, and that their interests were easily caught by playing games.

Table 1
Respondents of the Study

SECTION	Total	
	Number of Students (N)	Percentage (%)
ST. DOMINIC (Control Group)	25	50%
ST. JUDE (Experimental Group)	25	50%
TOTAL	50	100%

2.3 Data Collection Procedure

In conducting the study, the researcher followed the following, sequentially: validation of research instruments; asking permissions to the school head; administration of the pretest questionnaires; experimentation; administration of the posttest questionnaires; tabulation and data analysis.

Validation of Research Instruments. To ensure the strengths and validity of the research instruments, they underwent a due validation process.

Asking Permissions to the School Head. Prior to the conduct of the study, the researcher provided an authorization letter to the School Director/ Principal of the Assumption Academy of Monkayo, Inc. for his approval that this study would be conducted in the said school.

Administration of the Pretest Questionnaires. After the authorization letter was signed by the School Director/ Principal, teacher-made pretest questionnaires were administered to the respondents of this study – both to the control group and experimental group.

Experimentation. After administering the pretest questionnaires to the respondents of this study, the prepared modules were then given to the control group and experimental group, using traditional method of teaching and game-based learning strategy, respectively.

Administration of the Posttest Questionnaires. After the prepared modules were discussed to the control group and experimental group, using the assigned teaching strategies to each group. The teacher-made posttest questionnaires were administered to both groups

Tabulation and Data Analysis. After the administrations of the pretests and posttests, the scores of the respondents from their respective groups were gathered and tabulated. Analysis of these data was afterwards carried out using appropriate statistical tests.

2.4 Statistical Treatment of Data

Mean and Class Proficiency. These statistical tools were used to compute the mean and class proficiency of the control and experimental groups in terms of the pretests and posttests results, thus, providing answers to the problems 1 and 2.

t-test for correlated or dependent samples. This statistical tool was used to ascertain if there is a significant difference between mean posttest scores of the students in control group and experimental group. Hence, providing an answer to problems 3 and 6.

t-test for uncorrelated or independent samples. This statistical tool was used to answer problems 4 and 5.

3. RESULTS AND DISCUSSION

Competency Level of the Pretest Scores of Control and Experimental Group

Table 2
Competency Level of the Pretest Scores of Control and Experimental Group

Group	No. of students	Mean	Class Proficiency	Competency Level
St. Dominic (CONTROL)	25	11.82	59.1%	Did Not Meet Expectation
St. Jude (EXPERIMENTAL)	25	11.94	59.7%	Did Not Meet Expectation

According to the class proficiencies in the pretest, the control group scored 59.1% while the experimental group scored 59.7%, both of which fell short of the target. As a result, the two groups had low levels of topic knowledge since, according to the results, their class performance was below 60%. This suggests that the teacher must employ a method of instruction that facilitates the students' understanding of the material and meet their needs.

The method that mathematics is taught has a major impact on students' enthusiasm in learning the subject (Ukobizaba et al., 2021). Many students hate the topic of math. When talking about mathematics or any other related topic, many students come up with different excuses not to discuss numbers. According to Azmidar et al. (2017), a student's degree of interest is one of the internal elements that influences their learning achievement, especially in Mathematics subject. Thus, by employing effective teaching techniques it can guarantee effective learning through a variety of means.

Competency Level of the Posttest Scores of Control and Experimental Group

Table 3
Competency Level of the Posttest Scores of Control and Experimental Group

Group	No. of students	Mean	Class Proficiency	Competency Level
St. Dominic (Control)	25	12.04	60.2%	Fairly Satisfactory
St. Jude (Experimental)	25	13.62	68.1%	Satisfactory

Both the control and experimental groups achieved a satisfactory level of achievement based on the results of the posttest, as their class proficiency was over 60%. Nonetheless, the experimental group outperformed the control group in terms of achievement. This suggests that the teacher's use of game-based learning as a teaching strategy had a greater effect on the students' performance than the traditional method used to teaching mathematics.

Arcagok (2021) emphasized that game-based teaching strategies when employed in a variety of curricula, have a positive effect on students' academic development when compared to traditional methods. Whitton (2007) also highlighted that advocates of game-based learning contend that computer games, and educational games in general, may inspire and engage a new generation of learners in ways that traditional education cannot, as well as alter the way that students learn.

Comparison Between the Achievement of the Pretest Mean Scores of the Students in the Control and Experimental Group

Table 4

Comparison Between the Achievement of the Pretest Mean Scores of the Students in the Control and Experimental Group

Group	N	Mean	Computed t	Tabular t	Findings	Conclusion
Experimental	25	11.94		1.96 (2T)	Accept Ho1	Not Significant
Control	25	11.82	0.2298	$\alpha = 5\%$		

At the 5% level of significance, the computed t value in Table 4 is 0.2298, which is less than the two-tailed tabular t-value of 1.96. The null hypothesis was thus accepted, proving that there was no significant difference between the pretest mean scores of the students in the experimental group and the control group.

Comparison of the Achievement of the Students in the Control Group

Table 5
Comparison of the Achievement of the Students in the Control Group

Test	N	Mean	Computed t	Tabular t	Findings	Conclusion
Pretest	25	11.82		1.96 (2T)	Accept Ho2	Not Significant
Posttest	25	12.04	1.4745	$\alpha = 5\%$		

By comparing the academic results of the students in the control group, it is implied that the null hypothesis was supported and that there was not a significant difference between the students' performance in the control group when mathematics was taught using traditional methods. Learning by doing is essential to good understanding, as Noreen and Rana (2019) noted, because it has been shown that the more senses are activated, the more a person learns and the longer he or she remembers. Activities help the students become more knowledgeable and dynamic.

However, Haghighi et al. (2005) state that the traditional teaching approach mostly entails teachers lecturing to pupils while they sit still but engaged in thought. It is possible that pupils will jot down notes. Taking notes or remaining sitting to answer questions from the teacher are the main physical tasks that students complete throughout teaching and learning sessions in the classroom. Students become passive learners since there is no way for them to contribute to class debates or presentations. It renders the entire process of instructing with visual aids dull and lifeless. It provides little flexibility for either the teacher or the students.

Comparison of the Achievement of the Students in the Experimental Group

Table 6
Comparison of the Achievement of the Students in the Experimental Group

Test	N	Mean	Computed t	Tabular t	Findings	Conclusion
Pretest	25	11.94		1.96 (2T)	Reject Ho3	Significant
Posttest	25	13.62	11.8980	$\alpha = 5\%$		

Upon comparing the student achievements in the experimental group, it can be inferred that there was a significant difference in the student achievements when utilizing game-based learning as a teaching approach for mathematics instruction, and that the null hypothesis was rejected. According to Lai et al. (2014), using game-based learning to boost learning motivation is a common instructional strategy for enhancing learning outcomes.

Additionally, it has been demonstrated that educational games increase student enthusiasm, engagement, and learning by personalizing and adapting the curriculum (Hamdaoui et al., 2021).

Comparison Between the Achievement of the Posttest Mean Scores of the Students in the Control and Experimental Group

Table 7
Comparison Between the Achievement of the Posttest Mean Scores of the Students in the Control and Experimental Group

Group	N	Mean	Computed t	Tabular t	Findings	Conclusion
Experimental	25	13.62		1.96 (2T)	Reject Ho4	Significant
Control	25	12.04	4.4438	$\alpha = 5\%$		

When the achievements of the students in the control and experimental groups are compared, it is implied that there was a significant difference in the students' posttest results between the control and experimental groups, and that the null hypothesis was rejected. Bakan and Bakan (2018) claim that games give students the chance to learn by doing—living in a situation where they are actively involved and able to carry out their tasks independently.

Moreover, game-based learning encourages students to actively participate in gaming activities, which not only enhances but also retains student learning excitement and makes them desire to invest in time studying, in contrast to traditional education where students passively absorb information (Prensky, 2003, as cited in Lai et al., 2014).

4. CONCLUSIONS

The computation of the class proficiency in the pretest scores of the control and experimental groups proved that the competency levels were equivalent prior to the experiment.

After the experiment, the students in the experimental group had significantly varying competency levels. As a result, the intervention of game-based learning as a teaching method was successful. The game-based learning strategy was a way to offer an engaging and interesting classroom instruction. The traditional way of instruction and the game-based learning technique used in the presentation of the class both enhanced the academic performance of the students in the control and experimental groups, respectively. The outcomes proved that both strategies worked well in the classroom for teaching processes.

However, analysis revealed that the experimental group's intervention performed better in terms of achievements made. When using game-based learning instead of the traditional teaching method, the findings showed a significant difference. The use of educational games in teaching strategies improved student participation since they allowed them to connect the subjects to actual situations. Positive outcomes of the application of intervention were shown by the assessments of the hypotheses that were developed. A more effective alternative to the traditional instructional method is game-based learning in the teaching of mathematics. When a student knows how to apply what they have learned to real-life situations, they can become lifelong learners.

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