



GAME-BASED APPROACH AND STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS 9

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Abstract

This study is focused on the effectiveness of Game-Based Approach and Student's Academic Performance in Mathematics 9. It aimed to validate the Lesson Exemplars in Quadrilaterals, Similarity and Trigonometry, embedded with games and test its effect in the academic performance of the students. True experimental research design was employed in this study using the Pre-test-Posttest-Control Group Design. The subjects of the study were total of one hundred (100) Grade 9 students from a purposive sampling method. The control group was exposed to Traditional Approach and the experimental group was subjected to the Game-Based Approach. The mean was used to determine quality of the lesson exemplar as assessed by experts. The mean, standard deviation, t-test and probability test were utilized to determine the significant difference of the control group and the experimental group. Findings verified that the developed lesson exemplar suits the level of the learners. Results revealed that the mean scores of the control group and the experimental group were similar before the experimentation. However, the posttest scores revealed that games did help students to perform better in Mathematics as showed by the experimental group who performed significantly better in terms of academic performance than that of the control group.

Keywords: *Game-Based Approach, Academic Performance, Mathematics Learning, Mathematics 9, True Experimental Design,*

1. INTRODUCTION

Every learner's life is centered around math. It is acknowledged as one of the core academic subjects. However, there are many complaints that Mathematics is one of the more difficult and dull subjects, especially in secondary schools. The difficulty of instruction and the learning process itself are both affected by teachers' knowledge of the learning competencies and their abilities to teach them.

The 2019 reports of the Trends in International Mathematics and Science Study (TIMSS) showed that for the 58 participating countries, most were educating their students beyond minimum proficiency in science and mathematics. Ninety-two (92) percent of the students across countries reaching the low benchmark and only seven (7) percent met the advanced benchmark. They were those who were able to solve problems by applying their conceptual understanding.

The said report also showed that the Filipino students in Grade 4 also fall into low benchmark which shows that they only have the basic knowledge of the concept of mathematics. Both students and teachers experienced significant difficulties as a result of the pandemic brought on by the Corona Virus. These also caused chaos, and many students and their parents called out for assistance in learning through printed or online modules. Education trends transit from classroom to online and printed media. Most of the learners' worlds were turned upside down by these circumstances, which also caused more difficulties with learning in general and with mathematics in particular. Online learners

underestimate their abilities in terms of learning the material, finishing the course, performing better than their classmates and performing well than their schoolmates. (Bringula, R., Reguyal, J.J., Tan, D.D. et al.,2021)

When economy started to open to a new normal, the governments around the globe also forced to make their ends meet by letting the different facilities and institutions to operate back to normal. Thus, schools were also opened for face-to-face classes.

Learning Mathematics presented various challenges for many students. Mathematics is often associated as a difficult and tedious subject to learn (Sedig, 2008, as quoted by Belano, (2019). Therefore, teachers must innovate their teaching strategies to increase the engagement, motivation and learning of the students. One of the interesting strategies in teaching mathematics is by using games as a tool to a more comfortable teaching and learning process.

According to Ramli, 'Izzat Syahir Mohd, Maat, S. M., & Khalid, F. (2020), the application of Game-Based Learning (GBL) approach will encourage students to solve problems and self-learning and thus enable students to learn a mathematical concept without realizing it. As a result, students' self-esteem and self-efficacy can be improved and help improve student achievement in Mathematics.

In the transformation of our school systems from remote to face to face learning, it is important to capture the learners' attention from the screen of their gadgets to the presence of their classmates and teachers in the classroom. Thus, the researcher was interested to use the Game-Based Approach (GBA) to determine the improvement in learners' achievement in Mathematics in order to help promote easier and manageable teaching and learning environment.

It is important to develop a teaching strategy and plan that will help teachers to deliver the lesson with ease and happiness to the learners.

The presentation of this study is shown in Figure 1, the Conceptual Paradigm on the Game-Based Approach and Students' Academic Performance in Mathematics 9. The independent variables were the underlying factors in developing a teaching approach and how it was used for the learners based on the content, format, presentation and organization, and instructional aspect. The researcher took two groups and employed different approaches: the game-based approach for the experimental groups and traditional approach for the control groups in order to measure the effect of the GBA on the learners' academic performance.

This study aimed to investigate whether the use of Game Base Approach in the classroom could be more effective than Traditional Approach for improving the students' academic performance in Mathematics

This study was conducted during the Third Quarter of the Academic Year 2022-2023 and was delimited to the Game-Based Approach and academic performance in Mathematics of the Grade 9 Students of Tacurong National High School, New Isabela, Tacurong City. Two (2) sections of heterogenous Grade Nine (9) students were the respondents of the study.

The Game-Based Approach were limited to the following categories, namely: content, format, presentation and organization, and instructional aspect. This study focused on the experimental method of research and also limited on academic performance of the experimental and control group based on the adopted test instrument.

2. MATERIALS AND METHODS

This section highlights or discusses how the study was conducted. It outlines the procedure and strategies which was used to collect and analyze data. It consists of the description of the research design, variables considered, location of the study, target population, sample size and techniques, research instruments statistical tool, and data collection procedures and data analysis.

This study utilized True Experimental Research Design using Pretest-Posttest Control Group design to interpret and analyze data gathered from students on learning intervention in Mathematics 9. The mean scores of the pretest and the posttest of the control and the experimental group were evaluated using the t-test.

According to De Carlo (2018), several kinds of experimental designs exist. In general, designs that are **true experiments** contain three key features: independent and dependent variables, pretesting and post-testing, and experimental and control groups. In a true experiment, the effect of an intervention is tested by comparing two groups. One group is exposed to the intervention (the **experimental group**, also known as the treatment group) and the other is not exposed to the intervention (the **control group**).

This research was conducted at Tacurong National High School located at Barangay New Isabela, Tacurong City, Province of Sultan Kudarat, SOCSKSARGEN Region. The school offers Junior High School, Senior High School, Special Program for the Arts (SPA), and Science, Technology and Engineering Program (STEP). The total population enrolled for the School Year 2022-2023 was Six thousand, sixty-seven (6067), with three thousand six (3006) male students and three thousand sixty-one (3061) female students. There were seventeen (17) sections with nine hundred sixty-six (966) students in Grade 9.

The Grade 9 students of Tacurong National High School who were officially enrolled for School year 2022-2023 were the respondents of the study. They were selected through purposeful sampling.

Two (2) out of seventeen (17) sections in Grade 9 were considered as the respondents for the experimental group and control group. Fifty students from each section were randomly selected as respondents of the study. There was a total of 100 respondents.

The three teacher-evaluators for mathematics who evaluated the lesson exemplar as to its effectiveness for GBA in terms of four (4) factor measures: (1) Content, (2) Format, (3) Presentation and Organization, (4) Instructional Aspects, were highly proficient (Master Teachers) in mathematics.

This study employed the purposeful sampling technique. Out of the two (2) sections, one (1) was randomly selected as experimental group and the other was the control group.

The instrument used in this study was adapted from Belano (2019) with some. The questionnaires were based from the table of specifications (TOS) to ensure proper distribution of the test items.

To determine the level of academic performance of the respondents, the score was transformed to percentage score then transmuted using the DepEd Order No. 8 s. 2015 with corresponding grading scale shown on Table 1.

The GBA used by the researcher was embedded in the lesson exemplar. The teacher-evaluators evaluated the lesson exemplar as to its effectiveness for GBA in terms of four (4) factor measures: (1) Content, (2) Format, (3) Presentation and Organization, (4) Instructional Aspect. The Evaluation tool with the four-point Likert scale was adapted and based on the evaluation tool of the Guidelines and Processes for LRMS Assessment & Evaluation Version: Final Draft 1.0 dated March, 2009

To produce trustworthy study, the researcher followed a procedure. The researcher investigated on the effectiveness of the Game-Based Approach and Student's Academic Performance in Mathematics 9.

To analyze and interpret the data, this study used the following statistical treatments: The mean of the student's pretest and post test scores determined the level of the control and experimental group's Mathematical Performance.

To t-test determined the significant difference on the Mathematical Performance level of the control and experimental groups in pre-test and posttest,

This study also used t-test and standard deviation to determine if there was significant difference between the control and experimental groups in their mean gain scores.

3. RESULTS AND DISCUSSION

Level of Lesson Exemplar in terms of Content, Format, Presentation and Organization, and Instructional aspects.

The succeeding tables 3 to 6 present the weighted mean computation and the equivalent descriptive level of the Lesson Exemplar in terms of Content, Format, Presentation and organization and Instructional aspects.

The Table 3 shows the obtained weighted mean of all the indicators of 4.00, 4.00, 4.00, 3.78, 4.00, 4.00 and 3.89 respectively which fall under the verbal description of "Very Satisfactory". This implies that the lesson exemplar is chronologically arranged has appropriate content for instruction suitable for the student's level of development and understanding. It also provides for the development of higher order thinking skills and activities have potential to arouse interest of the students. The section total mean for content of 3.95 also falls under the verbal description of "Very Satisfactory". This signifies that the lesson exemplar passed above 91-100% the quality criterion, thus, it was suited to the level of the learners.

The findings on the study of Chiarello, et al. (2017) on "Board Games Creations As Motivating and Learning Tool for STEM" shows that the students exposed to board games are engaging and have strong motivational impact and a high didactical effectiveness. Results on the study of Pratama and Setyaningrum (2018), indicated that students who were exposed to the game-based learning within problem-solving method, obtain positive effect on cognitive and affective aspects. The advantage of this approach in understanding volume concept is that students do not need to memorize the formula too much so that it is easier for them to work on the problem. It is through this game activity that students are facilitated in gaining the conceptual understanding of the three-dimensional geometry.

The Table 4 shows on the level of the lesson exemplar in terms of format. All items were rated as "Very Satisfactory" which implies that the format of the lesson exemplar was suitable for the intended user. Size of letters was appropriate and was easy to read. Illustrations were simple and easily recognizable. It was attractive and appealing and culturally relevant. The computed section means of 3.84 with a verbal description of "Very Satisfactory" implies that the lesson exemplar passes 91-100% of quality criterion and was ready to use to the level of learners.

This is supported by the study of Fontanilla (2001) as cited by Solidarios (2012) which emphasized that for the learning to be effective, instruction should provide a lot of meaningful situations and experience.

The Table 5 reflects the Level of Lesson Exemplar on presentation and organization of the lesson exemplar. All indicators respectively with the mean ratings of 3.89, 4, and 4 fall under "Very Satisfactory. The computed total section mean is 4.80 with a verbal description of "Very Satisfactory". It indicates that the lesson exemplar passes above 91-100% of the quality criterion.

Chen and McNamee (2011) stated that games were actually a positive method in enhancing one's performance. According to them, children who were given the chance to play had clearer aims, better skills to use materials in order to solve problems as well as take actions in reaching a goal, better probability in connecting game materials and so on. Compared to a study done by Theorell et al. (2009), when they observed the effects of practice and transfer of executive functions in preschool children, they found that repeated games do enhance the children's memory. In addition, play activities have advantages in stimulating children's development in terms of cognitive, social development, and interpersonal children. This is related because at an early age, before entering school, children begin to develop mathematical skills

The Table 6 shows level of the lesson exemplar in terms of its instructional aspects. All indicators have a verbal description of "Very Satisfactory" which implies that the lesson exemplar contains learning tasks that are relevant to the interest of the learners. The computed section means of 3.78 have the verbal description of "Very satisfactory" which shows that it passes above 91-100% of the quality criterion.

Teachers should provide frequent opportunities for students to play games, and then let the mathematical ideas show up as students discover new patterns, relationships, and strategies (Rutherford, 2015 as cited by Nfon, N.F.,2018).

It is shown in Table 7 that the factor "Instructional Aspects" reveals the highest mean rating of 3.97 next is the "Presentation and Organization" with the mean of 3.96, followed by the "Content" with the mean rating of 3.95 and the lowest is the factor on the "Format" that indicates the mean rating of 3.84.

The overall rating of 3.93 on the effects of GBA as evaluated is interpreted as Very Satisfactory. This implies that the Game Based Approach prepared lesson passes 91-100% quality criterion and is worthy to be used in the classroom.

On Student's Academic Performance in Mathematics

On the desire of the educational institutions to help the students and increase the academic performance many teaching strategies had been developed and tested for the benefits of the learners. Games in learning mathematics can help students have a better understanding of mathematical concepts and applications (Sayed Yusoff et al., 2014). The use of games as intervention can serve as an effective tool to improve the preschoolers' early Mathematics performance as well as to develop their interest learning through games (Ompok, C.S., et al, 2021)

To determine the academic performance of the students in their pretest and posttest, the researcher computed the mean score of the control group and the experimental group and using the percentage score transmuted using the transmutation table in DepEd Order No. 8, s. 2015 known as Policy and Guidelines on Classroom Assessment for the K to 12 Basic Education Program.

Mean Scores and Descriptive Rating of the Respondents in the Pretest and Posttest

Table 8 presents the mean score level of the academic performance of the control group in the pretest and posttest.

As shown in Table 8 the mean scores for the pretest and posttest are 13.14 and 16.92 respectively. These got the equivalent transmuted score of 66 for the pretest and 68 for the posttest. The transmuted scores indicate that both in pretest and posttest the control group did not meet the expectations in performing in Quadrilaterals, Similarity and Trigonometry but the mean scores of the posttest of the control group is higher than the pretest which shows increase.

The Table 9 exhibits the level of academic performance of the experimental groups pretest and posttest. The pretest's mean score of 13.00 indicates did not meet the expectation and the posttest score of 19.84 also signifies that students did not meet the expectation in their performance on Quadrilaterals, Similarity and Trigonometry. The mean scores indicated a significant increase in the performance of the

To enhance instruction for learner game-based learning shown multiple positive outcomes. Game-based learning also has some implications to be addressed like transferability of skill and enough knowledge with game-design (James, 2020)

Difference between the Pretest Scores of the Experimental Group and the Control Group.

The comparison of the mean scores of the experimental in the pre-test is presented in Table 9. The t-test was employed to determine the prior level of performance and knowledge of the students in the topics Quadrilaterals, Similarity and Trigonometry. The data was used to test if the two groups are similar in terms of their intellectual capacity in the particular topics of study.

Table 10 presents the level of performance of the pretest of the control group and the experimental group. The mean scores of the pretest of the control group is 13.14 with the standard deviation of 3.34 and experimental group is 13.00 with the standard deviation of 3.66. The computed t-value of 0.211 and the probability value of 0.833 shows that there is no significant difference between two groups at the 0.05 level of significance and confirmed that the two groups were of the same level at the start of the experimentation. This can be related the to study of Rondina and Roble (2019) which revealed that the mean of the experimental and control group during pretest were almost identical. This is to ensure the

reliability of the experiment results, according to the study of Concepcion in 2007 as adopted by Dadivas (2015), we have to consider two groups with the same level of academic performance before the experiment. In the study of Guevarra (2016) as cited by Belano (2019), about the jar model strategy, it was found out that both the control group and the experimental group performed poorly during the pretest.

Difference between the Posttest Scores of the Experimental Group and the Control Group.

To determine the significance of the posttest test of the experimental group and control group, the researcher still utilized the t-test. Table 11 compares the mean scores of the control group and the experimental group statistically.

Table 11 shows the test results of the mean difference of the posttest scores of the control group and the experimental group. The table shows that the mean score of the control group is 16.93 and the mean score of the experimental group is 19.84. The t-value is -3.132 as shown in the table and the p-value is 0.003. As the table shows, since the p-value of 0.003 is less than the 0.05 level of significance we reject the null hypothesis thus the result shows that there is significant difference between the posttest scores of the control and experimental group.

This is supported by the study of Fontanilla (2001) as cited by Solidarios (2012) which emphasized that for the learning to be effective, instruction should provide a lot of meaningful situations and experience. According to Dadivas (2015) the careful selection and creation of the learning materials had greatly influenced the learning performance of the students in the experimental group.

Difference Between the Mean Gain Scores of the Control Group and the Experimental Group.

The test result on the significant difference between the mean gain scores of the experimental group and the control group is presents in Table 12.

Table 12 displays the mean gain scores of 3.78 and 6.84 of the control group and the experimental group. It is also shown in the table that the mean gain score of the experimental group that is 6.84 is relatively higher than of the control group that is 3.78 which implies that the experimental group who had been exposed to game-based approach had better performance in Mathematics than those in the control group who were used to traditional approach. With regard to the variability of the scores table that the control group is denser with 3.79 standard deviation than the 4.98 spread of the experimental group which means that control group had the same level of learning and retention while the experimental group had different levels of learning and retention of the lessons taken. The table also reflects the t-value of -3.579 and the p-value of 0.001. Since the p-value of 0.01 is less than 0.05 level of significance, hence we reject the null hypothesis which states that there is no significant difference between the mean gain scores of the experimental group and the control group. Therefore, as table presents, there is significant difference between the mean gain scores of the control group and experimental group.

The results of the study is parallel the study of Rondina, J.Q. & Roble, D.B. (2019). which implied that the students who were exposed to mathematical game activities had a better achievement scores than the students who were exposed to the traditional method of teaching. Belano (2019), also signifies that the group who experienced games had better achievement in Mathematics 9 than those who are exposed paper and pen test.

The study is also supported by Rauda, D. R., et al (2019), entitled, "The Use of Relations and Functions Games Based on Balanced Design in Mathematics Subjects to Improve Student Learning Outcomes", the results showed that there was an increase in student learning outcomes on cognitive aspects before and after using the game Relations and Functions in Mathematics subjects. Further supported by the results of the study of Ompok, C. S. @ C. C., Mei Teng, L., & Sapirai, J. (2021), that the use of games are effective in improving preschoolers early Mathematics performance. According to the pre and post test results, it reconfirmed that this study is parallel to previous literature about games that help students to perform better in Mathematics.

4. MAJOR FINDINGS

This study investigated the effectiveness of the Game-Based Approach in improving the student's academic performance in Mathematics 9 of Tacurong National High School located at Brgy. New, Isabela, Tacurong City. Specifically, it sought to answer the following questions: How do experts assessed the lesson exemplar for the Game-Based Approach; Content, Format; Presentation and organization; and Instructional Aspect? What is the level of pretest scores and posttest scores of the control group and experimental group? Is there significant difference between the pretest scores of the control group and experimental group? Is there significant difference between the posttest scores of the control group and experimental group? Is there significant difference between the mean gain scores of the control group and experimental group?

True Experimental Research Design using Pretest-Posttest Control Group was utilized using two groups exposed to the same topic and assessment styles conducted by the researcher. The control group was exposed to traditional teaching approach while the experimental group was exposed to a game-based learning approach.

The major findings of the study were summarized as follows:

The level of the Lesson Exemplar was 3.93 and interpreted as Very Satisfactory. It implies that the Game-Based Approach prepared lesson pass 91-100% quality criterion and is worthy to be used in the classroom.

The level of the pretest scores of the control group is 13.14 mean rating interpreted as "Did Not Meet the Expectations", and the mean scores of the posttest of 16.92 interpreted as "Did Not Meet the Expectations". The level pretest scores of the experimental group were 13.00 mean rating interpreted "Did Not Meet the Expectations" and the posttest score of 19.84 interpreted as "Did Not Meet the Expectations". The mean scores indicated a significant increase in the performance of the students.

There was no significant difference between the pretest scored of the control group and the experimental group as shown in the computed t-value of 0.211 and the probability value of 0.833 at the 0.05 level of significance. The first hypothesis was accepted.

There was a significant difference between the posttest scores of the control group and the experimental group with the computed t-value of -3.132 and the p-value of 0.003 is less than the 0.05 level of significance. The second hypothesis was rejected.

There was significant difference between the mean gain scores of the control and the experimental group as results shown with the t-value of -3.579 and the p-value of 0.001 which is less than 0.05 level of significance. The third hypothesis was rejected.

5. CONCLUSION

The researcher therefore concluded that the level of the lesson exemplar can be denoted as: chronologically arranged and has appropriate content for instruction suitable for the student's level of development and understanding, attractive and appealing and culturally relevant. logically flowed of the lesson and adaptive to the learner's level of understanding. Activities promotes cooperation and competition among learners and can be easily managed by groups or by individual set.

The control group and the experimental group performed at the same level of performance during the pre-test. The control group and the experimental group both increased their score during the posttest. The mean gain score of the experimental group was higher compared to the control group. The comparison of the posttest of the control group and the experimental group revealed that the experimental group performed with higher scores compared to the control group.

A well-planned and carefully designed lesson integrated with games greatly influenced the learning performance of the students in the experimental group as shown in the significant mean gain score difference compared to the control group. As the results permitted, the lesson exemplar for Mathematics 9 used as a supplementary material lesson guide is so much helpful and useful to the grade 9 students and is effective in the gradual development and improvement of academic performance in Mathematics.

Based on the findings and conclusions of the study, the following are the recommendations:

1. To ensure the quality of teaching and learning experiences, school administrators, department heads, and teachers may consider the integration of games in the lesson.
2. The teachers may incorporate innovativeness in terms of teaching and learning advancement in the class specifically in those that are motivating and encouraging to students in Mathematics like the Game-Based Approach.
3. The developed lesson exemplar in this study may be adopted as means to promote innovative teaching and learning.
4. The teachers and parents shall look into the learning needs of the pupils by providing them with the appropriate learning experiences.
5. Educators may be encouraged to create or innovate more educational games to increase students' performance.
6. Curriculum designers may be encouraged to establish innovative games as one of the learning priorities in the education program.
7. More studies regarding integration of games to teaching and learning process should be conducted to increase the quality of education and help ease students' difficulty specially in the area of Mathematics, Language and Science.
8. The lesson exemplar used in this study is limited only to one lesson per module on Quadrilaterals, Similarity and Trigonometry. Thus, it is recommended that further study with comprehensive scope will be done.
9. Replication of this study should be conducted in more controlled environment to validate the findings of this study.

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