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The Use of Simulation Games: Its Effectiveness in Teaching Mathematics

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Abstract

This experimental research aimed to determine the effectiveness of simulation games as a strategy in teaching Mathematics. The study was conducted at Passi City College, Passi City, Iloilo during the Academic Year 2019-2020. The subjects of the study were the forty eight (48) BSBA second year students enrolled in Statistics. The subjects of the study were randomly distributed into the control and experimental group. Data gathered were analyzed using the mean and t-test. The results revealed that the respondents exposed to both strategies have the same performance in the pre-test. The use of simulation games improved the performance of the respondents in Mathematics. Respondents exposed to traditional method of teaching improved their performance in Mathematics. Both groups have the same performance in the post-test described as "Satisfactory". The performance of the respondents in the pre-test exposed to traditional method and with the use of simulation games is almost the same. The performance of the respondents exposed to the use of simulation games in the pre-test and post-test differed significantly. Significant difference existed in the performance of the respondents exposed to the traditional method of teaching in the pre-test and post-test. The performance of the respondents exposed to both strategies in the post-test is comparable.

Keywords: simulation games, effectiveness, teaching mathematics

Introduction:

Mathematics education has long been recognized as a crucial aspect of a well-rounded education, providing students with essential problem-solving skills and analytical thinking abilities. Traditionally, mathematics instruction has relied on traditional classroom methods, which often struggle to engage students and promote active learning. However, the integration of simulation games into mathematics instruction has emerged as a promising approach to enhance student engagement and understanding. This paper aims to explore the effectiveness of simulation games in teaching mathematics, examining research studies that have investigated their impact on student learning outcomes.

Simulation games provide a dynamic and interactive learning environment that allows students to explore mathematical concepts in a practical and engaging manner. Research conducted by Sailer, et al. (2017) found that simulation games improved students' conceptual understanding of mathematical concepts compared to traditional instructional methods. The interactive nature of these games allows students to visualize abstract concepts, experiment with variables, and observe cause-and-effect relationships, leading to a deeper understanding of mathematical principles.

In addition, simulation games can be designed to adapt to students' individual learning needs, allowing for personalized instruction. Through real-time feedback and scaffolding, students receive

tailored support and guidance as they progress through the game. A study by Istrate and Nordseth (2018) explored the effectiveness of a simulation game for teaching fractions, showing that the adaptive features of the game helped students with different skill levels and learning styles to achieve improved performance and understanding.

The integration of simulation games in mathematics instruction has demonstrated numerous benefits, including enhanced conceptual understanding, improved problem-solving skills, increased motivation, and individualized learning. The cited research studies provide empirical evidence of the effectiveness of simulation games in teaching mathematics, highlighting their potential to transform traditional mathematics education into a more engaging and impactful experience for students.

It is in this context that the researcher is inspired to conduct a study on the effectiveness of simulation games in teaching Mathematics.

Statement of the Problem

This study aimed to determine the effectiveness of simulation games in teaching mathematics.
Specifically, it sought to answer the following questions:

1. What is the performance of the experimental group and control group in the pre-test?
2. What is the performance of the experimental group in the pre-test and post-test?
3. What is the performance of the control group in the pre-test and post-test?
4. What is the performance of the experimental group and control group in the post-test?
5. Is there a significant difference in the performance of experimental group and control group in the pre-test?
6. Is there a significant difference in the performance of the experimental group in the pre-test and post-test?
7. Is there a significant difference in the performance of the control group in the pre-test and post-test?
8. Is there a significant difference in the performance of the experimental group and control group in the post-test?

Hypotheses

To answer the above questions, the researcher hypothesized that:

1. There is no significant difference in the performance of experimental group and control group in the pre-test.
2. There is no significant difference in the performance of the experimental group in the pre-test and post-test
3. There is no significant difference in the performance of the control group in the pre-test and post-test.
4. There is no significant difference in the performance of the experimental group and control group in the post-test.

Conceptual Framework of the Study

The conceptual framework of the study is presented in Figure 1. The schematic diagram presents the interplay of the variables of the study. The dependent variable is the academic performance of the respondents in Mathematics while the independent variables are the approaches in teaching Mathematics: the use of simulation games and the traditional method of teaching.

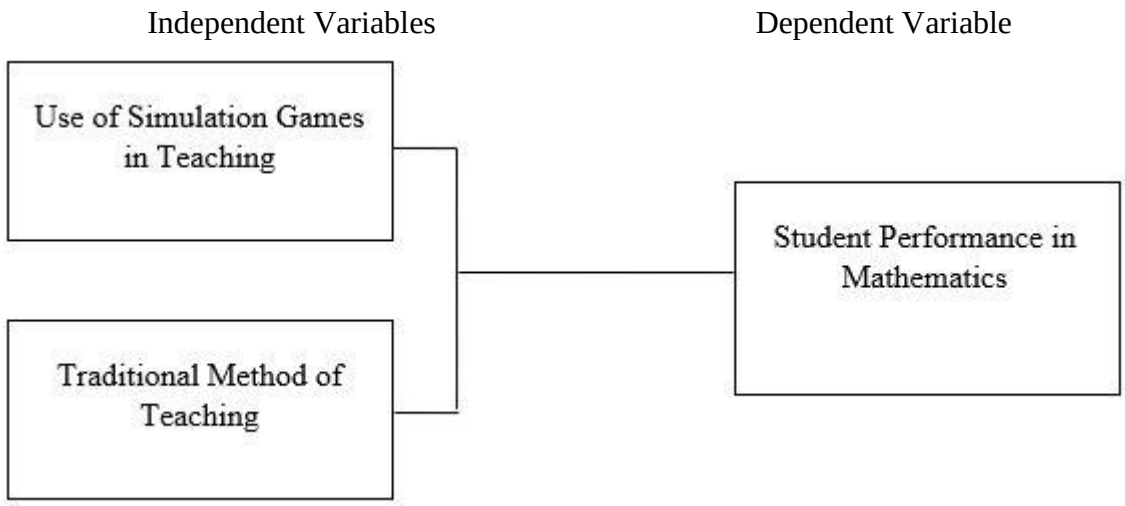

Figure 1. The Schematic Diagram of the Study

METHODOLOGY

Research Design

This study used the true experimental research design specifically the pretest-posttest control group design. Pretest-posttest control group design is one of the true experimental designs and it is considered stronger than the posttest only control group design because the improvement can be measured through gained scores (Nunan and Bailey, 2009). This method used the random selection and random assignments of the subjects. This study had two groups: one group was composed of students exposed to simulation games as strategy in teaching which was the experimental group and the other one was exposed to the traditional method of teaching which was considered as the control group.

Locale of the Study

The study was conducted at Passi City College, Passi City, Iloilo, Philippines during the Academic Year 2019-2020.

Respondents of the Study

The subjects of the study were the second year Bachelor of Science in Business Administration students taking Statistics.

Sampling Technique

Out of the 55 regular BSBA 2 students taking Statistics, 48 were chosen as the subjects of the study. The subjects of the study were distributed into two groups, the experimental and the control group through randomization. This process is called the random assignment of subjects to the group. Random assignment means that every individual who participated in the experiment has an equal chance of being assigned to any of the experimental or control conditions being compared (Acero and Leuterio, 2006).

A male and female ratio was considered in choosing the subjects. The total population comprised of twenty-eight (28) females and twenty (20) males. The participants were made parallel and comparable by matching each other according to their pretest results, previous average in Mathematics and sex. After equating them according to the parameters used, 14 pairs from the female group and 10 pairs from the

male group were randomly picked. Each pair was then given an assigned number and was drawn randomly to determine who will be in the control and experimental group respectively.

Research Instrument

The researcher utilized the following instruments to gather data needed in the study:

The test. A 50-item multiple choice test was used to determine the performance of the respondents before and after the study. This was subjected to validation and pilot-testing. The test that was administered in the pre-evaluation was the same test given in the post-evaluation. However, there were few alterations made such as rearrangement of items and options. This alteration or rearrangement was done in order to eliminate familiarity of the subjects on the test items. The researcher prepared the table of specifications in constructing the test. This was done in order to avoid duplication of the test item and to make sure that the test items were the representative samples in every content of the lesson.

The reliability of the test was determined using the Split-half method. The test items constructed gave an r of 0.84 which was described as highly reliable by Garret's interpretation of relationship.

Data Gathering Procedure

The researcher gathered data for the study by administering the pre-test and the post-test to the respondents. The result of the pre-test and post-test were the data needed to describe the performance of the respondents exposed to simulation games and traditional method of teaching.

The conduct of the study lasted for six weeks. Two separate classes were conducted and two schedule of classes were prepared. One period was assigned to group of students exposed to simulation games as strategy in teaching which was the experimental group; and another period of class was assigned to students exposed to the traditional method of teaching, referred to as the control group.

The data gathered were subjected to statistical analysis using the following statistical tools: Mean and t-test.

FINDINGS

Performance of the Experimental Group and Control Group in the Pre-test

Table 1 shows the performance of the experimental and control group in the pre-test. The result revealed that the performance of the respondents on both groups was "poor" with mean scores of 12.96 and 12.79 respectively. The study further revealed that in general the subjects of the study were similar in knowledge of course content at the beginning of the instruction. It can be noted that no treatment was given to both groups before the conduct of the pre-test.

Table 1. Performance of the experimental group and control group in the pre-test

Performance	Mean Score	Description
Experimental Group	12.96	Poor
Control Group	12.79	Poor

Legend:
45.00-50.00- Outstanding 27.00-32.00- Fair
39.00-44.00- Very Satisfactory 25.00-26-00- Passing

33.00-38.00- Satisfactory 24.00 and below- Poor

Performance of the Experimental Group in the Pre-test and Post-test

Table 2 summarizes the performance of the experimental group in the pre-test and post-test. The result of the pre- test revealed that the performance of the students before the study was "poor" as shown in the mean score of 12.96 but after the study, the post-test revealed that the performance of the subjects had increased and was described as "satisfactory" as shown in the mean score of 34.13. It has a mean gain of 21.17 or 163.35% from the pre-test. The increase in the performance of the subjects who were exposed to simulation games as aid in instruction connotes that exposing the subjects to simulation games strategies made the lesson easier. The simulation game used facilitate students' ability to build on prior knowledge and internalize new information. The present finding also affirmed the result of the study conducted by Carrem (2002) that simulation games improved and increased the performance of the students in Mathematics.

Table 2. Performance of the experimental group in the pre-test and post-test

Performance	Mean Score	Description
Pre-test	12.96	Poor
Post-test	34.13	Satisfactory

Legend:

45.00-50.00- Outstanding
39.00-44.00- Very Satisfactory
33.00-38.00- Satisfactory
27.00-32.00- Fair
25.00-26-00- Passing
24.00 and below- Poor

Performance of the Control group in the Pre-test and Post-test

Table 3 reveals the performance of the control group in the pre-test and post-test. The respondent's performance was "poor" (M=12.79) during the administration of the pre-test. However, the respondent's performance increased to "satisfactory" (M=35.42) in the post-test. It had a mean gain of 22.63 or 176.94% from the pre-test. According to Santrock (2006), learners are diverse in nature and that some may tend to learn traditionally. This factor may contribute to the increase of the performance of the subjects who are exposed to the traditional approach in teaching.

Table 3. Performance of the control group in the pre-test and post-test

Performance	Mean Score	Description
Pre-test	12.79	Poor
Post-test	35.42	Satisfactory

Legend:

45.00-50.00- Outstanding
39.00-44.00- Very Satisfactory
33.00-38.00- Satisfactory
27.00-32.00- Fair
25.00-26-00- Passing
24.00 and below- Poor

Performance of the Experimental Group and Control Group in the Post-test

Table 4 shows the performance in the post-test of the experimental and control group. The result revealed that the experimental group obtained a mean of 34.13 while the control group obtained a mean of 35.42 which were both interpreted as "satisfactory". This a clear indication that the experimental group and control group performed actively and participated in the class regardless of the strategies used by the teacher.

The findings of this study contradicts to the finding of Dawood (2006) which states that students in the class that participated in game playing showed an improvement on their test scores as compared to the students whose class did not participate in any games.

Table 4. Performance of the experimental group and control group in the post-test

Performance	Mean Score	Description
Experimental Group	34.13	Satisfactory
Control Group	35.42	Satisfactory

Legend:

45.00-50.00- Outstanding
39.00-44.00- Very Satisfactory
33.00-38.00- Satisfactory
27.00-32.00- Fair
25.00-26-00- Passing
24.00 and below- Poor

Difference in the Performance of the Experimental Group and Control Group in the Pre-Test

Table 5 reveals the difference in the performance of both groups in the pre-test. The t–test for independent samples revealed that there is no significant difference in the performance of students who used simulation games strategy in instruction and the traditional approach in instruction in the pre-test, t(24)=0.147, p=0.884. Thus, the null hypothesis which states that there is no significant difference in the performance of control group and experimental group in the pre-test was not rejected.

The result implies that at the beginning of the study, the subjects from the control and experimental group do not differ in terms of their knowledge in Statistics.

Table 5. t-test result showing the difference in the performance of the experimental group and control group in the pre-test

Variable	Df	n	Mean Score	t-value	Sig. (2-tailed)
Experimental Group	46	24	12. 96		
				.147^{ns}	0.884
Control Group		24	12. 79		

ns- not significant

Difference in the Performance of the Experimental Group in the Pre-test and Post-test

Table 6 shows the t-test result showing the difference in the performance of the respondents who were exposed to simulation games as aid in instruction in the pre-test and post-test. The t-test for dependent samples showed that there was a highly significant difference in the scores, t(24)=17.31, p=0.000. The null hypothesis which states that there is no significant difference in the performance of the experimental group in the pre-test and post-test was rejected.

Rendulic (1996) specifically indicated that games increase the students' internal motivation as well as their learning performances. Interestingly, Prensky (2003) pointed out that, from the perspective of successful learning, motivation is an indispensable condition and games just happen to provide such a condition.

Mahboubian (2010) states that some simulations provide a safe environment in which to make mistakes and allow learning to take place without pulling expensive equipment offline. This is also supported by Adobor and Daneshfar (2006) and Salas et al. (2009). Pasin and Giroux (2011) add that simulation games are more engaging and motivating than other teaching strategies (Salas et al., 2009). In addition to providing an enhanced learning experience, simulation games allow participants to learn complex skills in what can be characterized as an enhanced reality.

Table 6. t-test result showing the difference in the performance of the experimental group in the pre-test and post-test

Variable	Df	n	Mean Score	t-value	Sig. (2-tailed)
Pre-test	23	24	12. 96	17.31*	0.000
Post-test	23	24	34.13		

*-significant

Difference in the Performance of the Control Group in the Pre-test and Post-test

The t-test result on the difference in the performance of the control group in the pre-test and post-test is shown in table 7. The t-test result for dependent samples showed that there is a highly significant difference in the scores during the pre-test and post-test, t(24)=25.30, p=0.000. Based on the above findings, the null hypothesis which states that there is no significant difference in the performance of the control group in the pre-test and post-test was rejected at .05 level of significance. The finding implies that there is an increase in the performance after the conduct of the study. The control group though not exposed to an intervention still managed to cope with the lesson facilitated by the teacher-researcher. Furthermore, it tells that providing lecture, reading materials and other similar instructional materials can increase learning and performance.

The result of this study is in consonance with the findings of Vadiraj Udupa, et al. (2012) which states that students scored significantly higher in the posttest as compared to pre-test.

Table 7. t-test result showing the difference in the performance of the control group in the pre-test and post-test

Variable	Df	n	Mean Score	t-value	Sig. (2-tailed)
Pre-test	23	24	12. 79	25.30*	0.000
Post-test	23	24	35.42		

*-significant

Difference in the Performance of Experimental Group and Control Group in the Post-test

The t-test result on the difference in the performance of the subjects in the post-test using simulation games and traditional approach in instruction is reflected in Table 8. The t-test for independent samples revealed that there is no significant difference between scores of two groups in the post-test, t(24)=1.346, p=0.186. Therefore, the null hypothesis which states that there is no significant difference in the performance of the students who were exposed to simulation games as strategy in teaching and those who were exposed to traditional approach was not rejected. The result implies that whether traditional

approach or the use of simulation games in instruction was introduced, students' performance was the same and comparable. It means that students whether exposed to traditional or other mode of instruction still perform at their best and at the same pace. This indicates further that regardless of the use of simulation games, students learn to adjust and perform as expected. However, the use of traditional approach increased the performance of the students with the mean score of 35.42 when compared to the use of simulation game strategy in instruction with the mean scores of 34.13.

The result of the study negates the findings of Akinsola (2007); Randel, Morris, Wetzel, and Whitehill (1992); Pulos and Sneider (1994) that significant difference existed in the post-test achievement scores of the students between the two groups, showing that the students in the simulation game environment perform better than their counterpart in the control group.

Table 8. t-test result in the performance of experimental group and control group in the post-test

Variable	Df	n	Mean Score	t-value	Sig. (2-tailed)
Expiremental group	46	24	34.13		
				1.346^{ns}	0.186
Control group		24	35.42		

ns- not significant

Conclusions:

Based on the findings gathered, the following conclusions were drawn:

1. The respondents have "poor" performance in the pre-test.
2. Simulation games strategy increased the performance of the respondents.
3. Traditional method of teaching also improved the respondent's performance.
4. The respondents exposed to the traditional method of teaching and those exposed to the simulation games strategy were comparable in their post-test performance.
5. The performance of the respondents exposed to both strategies have the same performance in the pre-test.
6. The performance of the respondents exposed to simulation games strategy in the pre-test and post-test varied significantly.
7. Significant difference existed in the performance of the respondents in the pre-test and post-test after exposure to the traditional method of teaching.
8. The respondents in both groups have the same performance in the post-test.

Recommendations

The researcher formulated the following recommendations as drawn from the findings and conclusions of the study:

1. Mathematics teachers may use simulation games strategy in combination with traditional method in teaching Statistics.

2. Teachers need to reconceptualize their role as facilitators in the development of student's knowledge while employing simulation games in the classroom. Future researchers may use the same strategy on other concepts of Mathematics such as Algebra and Geometry.
3. Teachers may start encouraging more student-centered learning in their teaching methodologies like the use of simulation games as a teaching strategy. Likewise, administrators may also support and provide avenues for teachers' advancement especially on the use of alternative instructional strategies and software.
4. The upshots of the simulation games strategy can be best understood when studied quantitatively and qualitatively since academic and non-academic achievements could be assessed. Hence, the researcher highly recommend further studies to be undertaken with simulation games strategy which involve intensive and extensive use of the strategy.

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