MATHOPOLY: A LEARNING TOOL FOR DESCRIPTIVE STATISTICS

Lorelie C. Canada

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Abstract

The main thrust of this study was to determine the effectiveness of Mathopoly Game as a learning tool in learning descriptive statistics among the first year Bachelor of Science in Electrical Technology students of the College of Technology and Allied Sciences of Bohol Island State University-Main Campus. Specifically, this study aimed to determine the performance of the students before and after exposure to conventional teaching and Mathopoly Game. It also sought to determine the difference between the pretest and posttest of the control group, pretest and posttest of the experimental group, and posttest of both groups. It also sought to show the level of acceptance of the students towards Mathopoly Game in terms of the procedures or rules, learning content, design of the game, and experience in the game. This study utilized the experimental design, particularly the matching only quasi-experimental design. The test items underwent pilot testing and an item analysis before it was administered to the respondents. The data were treated using the average weighted mean and t-test. Based on the findings, the t-test computation showed significant difference between the posttest performance of the students exposed to Mathopoly Game and those who were not exposed to the game. It also reflected the students' level of acceptance in terms of the procedures or rules, learning content, design of the game, and experience in the game which was rated "strongly agree". This implied that the students had accepted the Mathopoly Game and showed favorable attitudes towards the game. Mathopoly Game can be used as an activity in helping students develop efficiency in learning the different categories of measures under descriptive statistics. In connection to the result of the study, the researchers recommend Mathopoly Game to the mathematics teachers to be used as a learning tool in enhancing students' statistical skills. The procedure, content, and design of the game are subject to further development to address the needs and interests of the learners. Future researchers who also want to study similar concerns may refer to this study for further development of the game.

Keywords: mathopoly, descriptive statistics, learning tool, effectiveness, acceptability

Instructor Bohol Island State University Main Campus, Tagbilaran City, Bohol

Email: canadalorelie01@gmail.com

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1. Introduction

Mathematics has been a part of the human search for understanding. For some reasons, people consider the learning of Mathematics as an important aspect which is intimately connected with our everyday life. Its logic, clarity, and conscientiousness have been proven useful in understanding and thinking about the world in all dimensions and facets of people's activities. This can be used in many ways such as calculating the cost of purchases, memorizing phone numbers and addresses, calculating the distances of orbits from their respective planets, and many more. Without knowing the basics of Mathematics, humankind will be totally hopeless.

Statistics, being a branch of mathematics which deals with the systematic collection, tabulation, presentation, analysis, and interpretation of quantitative data which are collected in a methodical manner without bias, is often viewed as another tough subject for students. However, one may be called on to conduct research in one's particular field of expertise, and hence, statistical procedures are involved as statistics is always a part of research. Thus, one must be able to design experiments, collect, organize, analyze, and summarize data, make reliable predictions and should be able to communicate the results of the study in his or her own words.

Mathematics is so essential especially for today's students whose anxiety must not cause them to dislike and discontinue the study of the subject. This can be done by reducing stress in the classroom, improving students' attitudes, and helping them become aware of the essence of Mathematics that they are learning. Thus, it is important that teachers develop techniques that will encourage students to embrace Mathematics.

Learning mathematics is a challenging task. In Constructivism, learners construct their own understanding. Learning is enhanced by social interaction and authentic learning tasks that promote meaningful learning. With this, learners become active meaning-makers, building upon current knowledge. Thus, teachers should design learning situations in which learners can work with others on meaningful learning tasks. Experiencing Math concepts would help students build lifelong skills.

Meanwhile, Philosophy of Progressivism by John Dewey states that the child grows and develops as a whole through his own experience or self-activity (Acero, et al., 2004). Moreover, advocates of Progressivism or Progressive Education maintain that the curriculum must be based on the interest and freedom of the student. Learning is meaningful if the student is instructed or trained on what he likes or what interests him (Tuibeo, 2005). This works on the premise that learning process is essentially experiencing, reacting, doing, and understanding. Therefore, students must be provided with opportunities where they can learn by doing.

Learning is defined as a relatively permanent change in one's behavior as a result of his interaction with the environment. Edward Lee Thorndike's Law of Exercise maintains the idea that "the connection between a stimulus and a response is strengthened by being exercised frequently, recently, and vigorously. The strength of a stimulus-response association can be increased by use while the connection can be weakened by disuse," (Aquino, 2009). This implies that teachers must provide students with opportunities to learn and practice mathematical tasks or exercises which promote mastery of the tasks provided. The mind can rarely recall new concepts after a single exposure but with constant practice, learning is enforced.

Moreover, Thorndike's Law of Effect states that "if a response is followed by a satisfying state of affairs, it tends to be repeated, but if a response is followed by an annoying state of affairs, it tends to be unrepeated," (Aquino, 2009). This simply shows the role of motivation in helping students develop positive attitude towards what they are learning.

As cited by Aquino (2009), Epstein and Rogers (2001) states that motivation refers to an internal state of arousal that often precedes behavior. Bilbao, et. al. (2006) also states that motivation energizes, directs, and sustains behavior that ultimately leads to higher achievement in the classroom. It makes the

learner get interested in learning and keeps the learner engaged in learning.

As a corollary, one of the principles of teaching states that, "An individual must be motivated in order to learn." It is a force which pushes one to take an action or drives him or her to perform something. Effective teachers are important factors in shaping student motivation and provide a great impact on students' performance. Hence, the teacher and the motivational activities have influence in shaping the behavior of every individual learner. Teachers must then select appropriate teaching methods and strategies that will encourage and motivate students to learn and enjoy the subject.

Students in the classroom learning need constant motivation from the teachers so that optimum use of their talent may be made for their development. Therefore, techniques that the teachers employ to arouse and maintain motivation will be successful only insofar as they make them perceive that progress is being made towards need-satisfaction (Zikr-ur-Rahman, 2004). Hence, students who are motivated to learn are eager to be involved in any learning activity.

Knowing the fact that learners have multiple intelligences and varied learning styles, teachers should create learning environments in which different kinds of students can excel. Teachers should provide learning activities that suit to students' varied learning abilities and preferences since students learn differently.

Teaching Mathematics is not an easy task since most students dislike this subject. Due to its complexities, it is a great challenge for teachers to make students learn to love Mathematics. Teachers must then think of ways to make Mathematics as interesting as possible. With this fact, teachers learn to vary the teaching-learning process to a certain degree and learn to incorporate the use of games in teaching mathematics to arouse students' interests towards the subject.

Research has shown that students are more likely to be actively engaged in learning Math while playing games and doing hands-on projects rather than learning in the traditional Math classroom. Educators have been researching the effects of Math games against traditional Math instruction for many years. There appears to be an acceptance that Math games are beneficial to the students.

Based on the study conducted by Leicha Bragg about "Children's Perspectives on Mathematics and Game Playing", it has been proposed that students learn best through social interaction or by actively exploring concepts with their peers. Class discussions generated when playing games enhance the students' understanding about Math. This study was conducted to 210 grade 5 and 6 students. Interviews were being conducted with students to gather data on their attitudes towards Mathematics and game playing. The result from the interviews conducted showed both positive and negative feedback about the students' experience with playing Math games. The students' also voiced out that they learn better when they were performing enjoyable activities such as games.

When students are having fun and playing, they are more relaxed and those help them learn Math concepts as well as increase their self-confidence and the belief that they are capable. According to a research of Jacqui Allen (2010) about how Math games affect student engagement and achievement, the use of Math games in the classroom increased the students' engagement and involvement throughout their learning. The Math games were administered to Grade 6 students and the result shows that games created a classroom culture where students are more comfortable sharing their thinking about Math concepts, whether right or wrong. This helped students see that Math can be fun and it provided them with more confidence.

Leinhart as cited by Abne, et al. (2007) noted the use of particular teaching strategies that will enable students to learn and develop the conceptual understanding of the central content of the unit. This points out the mastery of the basic concepts in mathematics to prepare students and make them ready for higher Mathematics.

Thus, with this variation in the teaching-learning process, students will be motivated to learn. With the use of mathematical games,

students tend to develop positive attitude towards Mathematics. Greater learning occurs through games due to the increased interaction between children. Also, games allow children to operate at different levels of thinking and to learn from each other. Because of this, learning of math concepts becomes easier with an element of fun.

Understanding descriptive statistics will serve as an edge to one who will undergo research studies especially for tertiary students. This shall serve as a firm foundation that will help students conduct their own researches with ease. Taking these into consideration, the researchers find interest to conduct a study about the effectivity of Mathopoly, a mathematical version of the classic board game, Monopoly. This game is similar to the Monopoly game but variations are made with regards to the game's design and rules of the game play. This game aims to enhance students' learning in descriptive statistics as they venture into the world of research. Thus, the result of this study would serve as the basis for the implementation of Mathopoly as a learning tool that could help enhance students' statistical ability.

2. Methodology

The study used the experimental design, particularly the matching-only quasi-experimental design. The design is composed of pretest, discussion, experimentation, and posttest. The result of the pretest served as the basis in dividing the students into two groups. The students who got high and low scores were equally distributed in the groups. The control group was exposed to the conventional method of teaching while the experimental group was exposed to the mathopoly game.

The study was conducted at Bohol Island State University Main Campus, Bingag Extension Campus, Bingag, Dauis, Bohol. The researchers used the purposive sampling method wherein the first year Bachelor of Science in Electrical Technology students were chosen as the respondents for the study. They were chosen since they are taking up Elementary Statistics with descriptive statistics as part of the subject matter. The students were grouped based on the results of the pretest conducted wherein the scores were distributed fairly in each group.

3. Results And Discussion

This presents the findings, analysis, and interpretation of the gathered data on the performance of the first year Bachelor of Science in Electrical Technology students exposed to the conventional method of teaching and the Mathopoly game in learning descriptive statistics.

TABLE 1 Pretest Performance in Descriptive Statistics
N = 39

Score	**Description**	**Control**		**Experimental**	
		Frequency	%	Frequency	%
25-30	Excellent	0	0	0	0
19-24	Very Good	1	5.26	1	5
12-18	Good	11	57.89	10	50
6-11	Fair	6	31.58	8	40
0-5	Poor	1	5.26	1	5
Average Score		12.37		12.30	
Description		Good		Good	

Table 1 shows the frequency of the performance of the control and experimental group before exposure to the conventional method of teaching and Mathopoly game. It shows that the control group has an average score of 12.37 described as "good" while the experimental group obtained an average score of 12.30 described also as "good".

Both groups have relatively similar performance before they were introduced to the conventional teaching and Mathopoly game. This was the result of the exact pairing of the

students for each group. The performance of both groups also portrays that the two groups of respondents were comparable in terms of achievement level.

TABLE 2 Posttest Performance in Descriptive Statistics
N = 39

Score	**Description**	**Control**		**Experimental**	
		Frequency	%	Frequency	%
25-30	Excellent	1	5.26	10	50
19-24	Very Good	7	36.84	8	40
12-18	Good	9	47.37	2	10
6-11	Fair	2	10.53	0	0
0-5	Poor	0	0	0	0
Average Score		16.63		25.65	
Description		Good		Excellent	

Table 2 illustrates the performance of the students after exposure to the conventional method of teaching and Mathopoly game.

It shows that the control group has an average score of 16.63 described as "good" while the experimental group obtained an average score of 25.65 described as "excellent". From this, we can say that learning takes place in both groups even if they were exposed to different instructional strategies. However, better learning was observed when students were exposed to the mathopoly game. This can be associated to the concept of Constructivism wherein learners construct their own understanding. Learning is enhanced by social interaction and authentic learning tasks that promote meaningful learning. Thus, this allows learners to build personal understanding of their own knowledge and this could be attributed to the learning activities provided to them like the Mathopoly game.

TABLE 3 Difference between the Pretest and Posttest Results of the Control and Experimental Group

	Computed Value	**Tabular Value**	**Interpretation**	**Decision**
	at 0.05 level of significance			
Pretests of the Control and Experimental Groups	0.81	±2.024	Insignificant	Accept the null hypothesis
Pretest and Posttest of the Control Group	-6.35	±2.101	Significant	Reject the null hypothesis
Pretest and Posttest of the Experimental Group	-4.28	±2.093	Significant	Reject the null hypothesis
Posttests of the Control and Experimental Groups	3.85	±2.024	Significant	Reject the null hypothesis

Table 3 shows the difference between the performance of the control and experimental groups. The first row of the table presents the difference of the pretest of the conventional teaching and Mathopoly game. The computed t-value of 0.81 is within the tabular value of ±2.024 at 0.05 level of significance. Thus, the null hypothesis was accepted. This implies that there is no significant difference between the

knowledge of the topic that both groups possessed.

The second row shows the difference between the pretest and posttest performance of the students exposed to the conventional method of teaching and Mathopoly game.

There is a significant difference between the pretest and posttest performance in the control group because the computed t-value of -6.35 is beyond the tabular value ±2.101. Thus, the null hypothesis is rejected. Thus, learning takes place even with the conventional method of teaching.

There is also a significant difference between the pretest and posttest performance of the students in the experimental group because the computed t-value of -4.28 is beyond the tabular value of ±2.093. Thus, the null hypothesis is rejected.

This result could be attributed to Thorndike's Law of Exercise which states that "the connection between a stimulus and a response is strengthened by being exercised frequently, recently, and vigorously. The strength of a stimulus-response association can be increased by use while the connection can be weakened by disuse," (Aquino, 2009). Both methods provide students with opportunities to practice solving mathematical expressions in different environments that would enable them develop mastery about the lesson.

The third row shows the difference of the posttest of the control and experimental groups. The computed t-value of 3.85 is beyond the tabular value of ±2.024 at 0.05 level of significance. As a result, the null hypothesis was rejected. This shows that there was a significant difference between the performance of the students after they were exposed to the conventional method of teaching and Mathopoly game. Hence, better learning occurs in the Mathopoly game.

Thus, with the use of mathematical games, students tend to develop positive attitude towards Mathematics. Greater learning occurs through games due to the increased interaction between the students. Also, games allow children to operate at different levels of thinking and to learn from each other. Because of this, learning of math concepts becomes easier with an element of fun.

TABLE 4 Level of Acceptance of the Students towards Mathopoly
N = 39

Items	**Weighted Mean**	**Description**
A. Procedures/Rules		
1. The instructions are clearly stated.	3.28	Strongly Agree
2. The instructions are well-presented.	3.28	Strongly Agree
3. The procedures are properly organized.	3.43	Strongly Agree
4. The game is easy to play.	3.40	Strongly Agree
5. The rules of the game are understandable.	3.55	Strongly Agree
Average	3.39	Strongly Agree
B. Learning Content		
1. The content of the game enhances knowledge on descriptive statistics.	3.50	Strongly Agree
2. The content improves my learning descriptive statistics.	3.56	Strongly Agree
3. The problems are challenging.	3.60	Strongly Agree
4. The game develops mastery of skills in descriptive statistics.	3.56	Strongly Agree
5. The game is suitable to the topic on descriptive statistics.	3.65	Strongly Agree
Average	3.57	Strongly Agree
C. Design of the Game		
1. The game is time-consuming.	3.28	Strongly Agree

2. The game looks complicated.	3.40	Strongly Agree
3. The game is designed according to the interest of the students.	3.55	Strongly Agree
4. The materials being utilized are presentable.	3.44	Strongly Agree
5. The materials used are durable.	3.40	Strongly Agree
Average	3.41	Strongly Agree
D. Experience in the Game		
1. The game lessens boredom.	3.50	Strongly Agree
2. The game is interesting and fun to play.	3.38	Strongly Agree
3. The game is challenging.	3.46	Strongly Agree
4. The game increases competence.	3.56	Strongly Agree
5. The game aids in the learning of the students.	3.51	Strongly Agree
Average	3.48	Strongly Agree
Overall Average	3.46	Strongly Agree

Table 4 presents students' level of acceptance towards Mathopoly game as a learning tool. Students had a positive reaction towards Mathopoly game since the grand mean is 3.46 described as "strongly agree". It can be seen that all items in the questionnaire were rated "strongly agree". This indicates that they found the game helpful in learning descriptive statistics which is a prerequisite skill in research.

The general acceptability of the game maybe due to the fact that students are more likely to be actively engaged in learning Math while playing games and doing hands-on projects rather than learning in the traditional Math classroom. This can be associated with the research of Jacqui Allen (2010) about how Math games affect student engagement and achievement wherein he concluded that the use of Math games in the classroom increased the students' engagement and involvement throughout their learning. This denotes that the Mathopoly game can be used as a learning tool that can help enhance students' performance in descriptive statistics.

4. Conclusion

Based from the findings of the study, it was found out that the pretest results have significant difference to their posttest results, both in conventional method of teaching and using the Mathopoly game as a learning tool. Moreover, significant differences between the posttests of both groups were found signifying that incorporating games in learning descriptive statistics helped enhanced students' understanding of the lesson. Also, the students have a positive attitude towards Mathopoly game. Hence, Mathopoly can be used as a learning tool in learning descriptive statistics for it helps stimulate students' interest to learn the subject.

Recommendations

Based on the conclusions drawn from the study, the researchers came up with the following recommendations:

1. Teachers may use the Mathopoly game as an alternative tool in enhancing students' performance in mathematics.
2. Teachers and school administrators may require the integration of educational games especially in teaching mathematics.
3. For the future researchers, the procedure, content, and design of the game also are subject to further development to address the needs and interests of the learners.
4. Future researchers may conduct similar studies to further verify the effectiveness of Mathopoly game. It is recommended for them to increase the number of exposure to the conventional method of teaching and Mathopoly Game.

5. References

Abne, H., Casusula, J., Pacot, L. M., Talictic, E., & Toong, I. (2007). "Algebricks: an alternative learning strategy in algebra".

Undergraduate Thesis. CVSCAFT - TCC, Tagbilaran City

Acero, V., Castro, H., & Javier, E. (2004).Human growth development and learning. Manila: Rex Bookstore, Inc.

Allen, J. (2010). How do math games affect student engagement and achievement?. Retrieved from jacquis_thesis.pdf

Aquino, A. (2009). Facilitating human learning. Quezon City: Rex Book Store, Inc.

Bilbao, P., Corpuz, B., Llagas, A., & Salandanan, G. (2006). The teaching profession. Quezon City, Philippines: Lorimar Pub. Co., Inc.

Bragg, L. Children's perspectives on mathematics and game playing. Retrieved from RR_bragg.pdf

Tuibeo, A. (2005). Philosophy of education (a new perspective). Makati City: Grandwater Publication

Zikr-ur-Rahman (2004). Modern teaching methods and techniques. New Delhi, India: Anmol Publications Pvt. Ltd.