Flip the Tin Can Game with a Twist: Effects on the Achievement Levels of Grade 8 Learners in Probability

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Abstract

This study investigated the effects of the "Flip the Tin Can Game with a Twist" on the achievement levels of Grade 8 learners in probability. The study was conducted at St. Vincent's Academy, Inc. Lanao del Norte. A quasi-experimental design with qualitative support was employed, incorporating both quantitative and qualitative data. Two groups were involved in this study: the control and experimental groups. Both groups were given a pretest before introducing the "paper and pencil test" for the control group while" "flip the tin can game with a twist" for the experimental, as their formative assessment. Post-test was also administered after the interventions to both groups. The data gathered before and after exposing the learners in both control and experimental groups were compared to check if there is a significant difference. The findings of the study indicated a statistical difference in the mean test scores within both the control and experimental groups before and after the intervention. However, no significant difference was observed when compared between the group's pretest and posttest. Additionally, based on the learner's perceptions, it was discovered that those who participated in the 'Flip the Tin Can' game with a twist found it enjoyable and fun. Furthermore, according to the learners, the game not only provides enjoyable experience but also actively engages them in learning; enhancing their understanding of the subject while playing.

Keywords: Achievement Levels, Flip the Tin Can Game, Probability, Quasi-Experiment,

1.0 Introduction

In our daily lives, mathematics is integral part. It is used in many activities like grocery shopping, paying bills, budgeting every week, building and designing structure, taking medication, cooking and analysing data. Mathematics is one of the core subjects in the school curriculum and serves as a unique and particular subject (Gafoor & Kurukkan, 2015). One of the objectives of mathematics education is to inspire and equip learners with the skills necessary to analyze and solve problems in their daily lives by applying mathematics (Mazana, Montero, & Casmir, 2020). However, some learners struggle and experience confusion when performing or understanding math concepts. According to the National Educational Testing and Research Center Report revealed a decline in Mathematics achievement among students based on the analysis of National Achievement Tests from school years 2004-2006 and 2010-2011. Additionally, according to the Trends in International Mathematics and Science Study (2019), learners in the Philippines have among the lowest results in the world regarding their performance on international standardized tests in subjects like mathematics and science (Magsambol, 2020). Moreover, out of 81 participating countries the Philippines ranked poorly in the 2022 Programmed for International Student Assessment (PISA).The PISA results, showed that Philippines ranked third from the bottom in science with an average score of 356, sixth from the bottom in mathematics with an average score of 355, and sixth from the bottom in reading with an average score of 347 (Montemayor, 2023).One assumption that may be drawn from this is that the learners in the Philippines have difficulty answering questions or doing mathematical operations. Furthermore, the poor achievement levels among learners in the Philippines on mathematics and science tests suggest that they encounter difficulties with their problem-solving skills.

In line with this, it has been noted that learners face challenges when it comes to a particular branch of

mathematics, namely statistics and probability. According to Arum, Kausmayadi, & Pramudya (2018), the common misunderstandings about probabilistic concepts and the challenge of using the word or probability term in mathematical contexts contribute to the difficulty experienced by the learners. Anggraini & Kusrini (2018) concluded in their study that learners are having difficulties solving probabilities because of difficulty understanding proportional reasoning and resolving misconceptions or misperceptions of probability. Therefore, there has to be some kind of effective solution to help the learners comprehend the fundamentals of probability and to keep the learners engaged in the process of acquiring this knowledge. A learner's growth and learning depend on their engagement and motivation. Learners who are interested in what they are doing learn more, remember more, and enjoy learning more than learners who aren't interested (Antonio & Tamban, 2022).

Games are often used to increase motivation and engagement to learn any subject, particularly in mathematics (Bayeck, 2020; Ernest, 1986; White & McCoy, 2019, as cited in Nurnberger-Haag, Wernet, & Benjamin, 2023). This impression was supported by the study of Rutherford (2015) that learners may be motivated to learn about and practice fundamental mathematical concepts like number combinations, place values, and patterns by playing interesting mathematical games.

The "Flip the Tin Can Game" is one of the games that help learners in their learning process and improve their understanding in mathematics, especially in probability. This is a enhance game from a popular game in social media known as "flip bottle" where players are challenged to flip a plastic bottle, which is often filled with water, in such a way that it lands upright on a level surface after being flipped. While this game may not seem to have an obvious connection to education, it can be integrated into the classroom in a variety of ways to promote learning outcomes. Kelly (2017), an educator and a vlogger, shared a game in her blog post, which she used to capture the interest of her learners. The title of her activity is "Bottle Flipping: A Probability Activity. The said activity calculates the probability of successfully flipping a bottle and having it land upright. In this study, the "Flip the Tin Can Game" used a can in the game instead of a bottle. Based on the conducted dry run of the game, the researcher found out that learners had difficulty in flipping the bottle, which resulted in a lengthy time consumption. This led to the choice of using a tin can instead of a bottle. The tin can used was sourced from condensed milk, as it is a commonly available size often used by children when playing games like "tumbang priso." The Flip the Tin Can game which was used as a subject for experimentation in this research was applied with a twist.

This game challenged participants to get the highest possible score in answering the mathematical problems, as well as the challenge of flipping the tin can correctly. Thus, by adding games like Flip the Tin Can Game to the learning process, learners enjoy more which in turn leads to more learning. With this, the researcher wanted to know the effectiveness of the flip the tin can game with a twist as a formative assessment of learners' achievement levels.

1.2 Research Hypothesis

The researcher put forward the following hypothesis:

1. There is a significant difference in the mean scores of the achievement levels within the control group and experimental group.
2. There is a significant difference in the mean scores of the achievement levels between the control group and experimental groups.

1.3 Significance of the Study

The primary purpose of this study is to determine the effectiveness of a Flip the Tin Can Game with a Twist as a formative assessment in teaching Probability to Grade 8 learners. With this, this study will be beneficial to the following:

1. *To the learners.* This study will be beneficial to learners who want to develop their interest in learning the mathematical concept of Probability. Since not all learners are good at probability, the learners will be motivated to answer the questions with the help of the Flip the Tin Can Game with a twist.
2. *To the teachers*. Insights drawn from this study guided the mathematics teachers while teaching Mathematics and inspire them to conduct research on strategies in teaching Mathematics.
3. *To the school administrators.* The school administrator will consider adding upgraded instruments to their curriculum or, at the very least, equipping learners with the tools to learn while having fun while being taught probability. This will also allow them to think of better training for their teachers to be more innovative and well-equipped in teaching.
4. *To future researchers.* The results of this study will be used to do more research that will make teaching and learning more effective, relevant, and significant.

1.4 Scope and Limitations of the Study

The subjects of this study were two sections of Grade 8 learners: San Lorenzo and San Pedro from St. Vincent's Academy Inc., a private school located in Kauswagan, Lanao del Norte. This school follows the

DepEd's Most Essential Learning Competencies (MELCs) for the school year 2022-2023, which served as the basis for my study. The study had a span of two months, which was conducted during the Fourth Quarter (May - June 2023) during which five competencies were covered. The study ran for the entire two-month duration. The two Grade 8 sections of St. Vincent's Academy Inc. were divided into control group and experimental group. The control group which is section San Lorenzo received traditional teaching methods of assessment on the other hand section San Pedro where the experimental group engaged in the Flip the Tin Can Game with a Twist. To collect data for this study, an achievement test (teacher-made test), and a questionnaire with interviews were utilized. The topics were under Basic Probability in Grade 8 based on the mathematics curriculum guide's Most Essential Learning Competencies (MELCs). The topics covered were the last five (5) competencies for the fourth quarter of the K to 12 Curriculum and were suitable for two (2) months of implementation. In particular, Monday to Thursday regular classes were done for both control and experimental group. For control group classes starts at 8:30 AM to 9:30 AM, while for experimental group starts at 1:45 PM to 2:45 PM. After the four(4days) lecture or every Friday the experimental group learners will play the "Flip the tin can games while the control group will have a paper pencil activity.

These competencies were: (i) illustrating an experiment, outcome, sample space, and event (ii) counting the number of occurrences of an outcome in an experiment: (a) table; (b) tree diagram; (c) systematic listing; and (d) fundamental counting principle (iii) finds the probability of a simple event (iv) illustrates an experimental probability and a theoretical probability and (v) solves problems involving probabilities of simple events. The results of the achievement test and the learner's responses in the perception questionnaire were supported by a short interview which served as a ground for investigation in terms of the effectiveness of Flip the Tin Can Game with a Twist as a formative assessment and its effects on the student's achievement level in Probability.

1.5 Definition of Terms

The following terms were defined conceptually and/or operationally:

Achievement. It refers to the result of the pre-test and post-test of the learners made by the researcher.

Achievement Test. It refers to a 25-item validated researcher-made test that will be administered to learners before and after the implementation of Flip the Tin Can Game.

Achievement Level. It refers to the interpretation of the learners' achievement or scores in the pre and post-achievement test.

Control Group. It refers to the group of learners who are exposed to the traditional method of assessment.

Effectiveness. It refers to the degree to which intervention or treatment achieves its intended outcomes, based on objective criteria established by the researcher, rather than simply obtaining desired results.

Empty Can. This can is from condensed milk and it used as a tool in playing the "Flip the tin can game".

Experimental Group. It refers to the group of learners who are exposed to the Flip the Tin Can Game Activities in Probability.

Flip the Tin Can Game with a Twist. It refers to the usage of the game as a formative assessment tool in the experimental group of the study, which in this game learners' challenges to get the maximum or highest score possible in answering the presented mathematical problems, as well as the challenge of flipping the tin can correctly and having it fall right-side up on its bottom before they are given a chance to answer.

Perception. It refers to the student responses on a scaled questionnaire that is supported by their responses to the open-ended questions on their experiences and views on the use of the Flip Tin Can Game Activities in Probability

2.0 Methodology

This chapter presents the procedures utilized by the researcher for data collection. It consists of the research method, subject of the study, data gathering procedures, and statistical tools and treatment of the data to come up with realistic, reliable, and valid results

2.1 Research Method

In this study, the researcher utilized a mixed method that is a quantitative method with qualitative support. On the quantitative part, the researcher used the quasi-experimental while on the qualitative part, the open-ended perception questionnaire supported by short interviews was utilized. There were two groups of participants in this study: the control and the experimental group. Both groups received the same approach of teaching, but during the assessment, the control group used the traditional method of assessment, paper and pencil test, while the experimental group played the "Flip the Tin Can Game with a Twist". Both the control and experimental groups received pre and post-test. The learners' perception was used as a qualitative data to support quantitative data.

2.2 Subject of the Study

A purposive sampling method was employed in this study. Table 1 below shows the number of participants in the study, comprising two sections of Grade 8 learners in St. Vincent's Academy, Inc., Lanao del

Norte during the school year 2022-2023. A total of 95.15% (98 out of 103) of the table where the respondents of the study are two selected sections of grade 8 level learners. To determine which section would be assigned to experimental group and which in the control group a random technique was employed through flipping a coin. If the result of the coin flip was heads, the section with the bigger population of learners becomes the experimental group. On the other hand, if the result is tails, the section with the lowest population of learners becomes the control group.

The original number of learners in control group or section San Lorenzo and experimental group or section San Pedro were 51 and 52 respectively. However, only 96.08% (49 out of 51) in control group and 94.23% (49 out of 52). To check on the comparability of the experimental group and control groups the researchers had conducted a pretest in their probability class. The control group obtained a mean score of 10.18, while the experimental group had a mean score of 10.0610. These scores indicated comparability between the two groups.

Table 1, Matrix of the Participants

Group	Section (Groupings)	N	n	Mean Score (Pre-Test)
Control	San Lorenzo	51	49	10.18
Experimental	San Pedro	52	49	10.-06

2.3 Instruments Used
The researcher utilized the following instruments in the study:
2.3.1 Achievement Test
The achievement test was used to measure the achievement levels of the students. It is a 25-item achievement. A Table of Specifications was utilized in this study and the items were analysed to ensure the content validity of the test
2.3.2 Perception Questionnaire
The perception questionnaire consisted five (5) questions supported by a short interview, which aimed at understanding how the Flip the Tin Can Game with a Twist affected learner's learning in Probability and allowed them to describe and share or express their thoughts and experiences with the game.
2.3.3 Flip the Tin Can Game with a Twist
Flip the Tin Can with a Twist is a game designed to help learners learn more effectively and engage in the learning process. This game concept challenged participants to get the highest score in answering the mathematical problems added with the challenge of flipping the tin can correctly and having it land right-side up on its bottom before they were given the chance to answer.

2.4 Data Collection
The following were the steps that were followed by the researcher in implementing the study:
2.4.1 Asking Permission
The researcher asked permission from the school principals of St. Vincent's Academy, Inc. in Kauswagan, of Lanao del Norte to conduct the research study. Upon receiving permission, the researcher also sought the cooperation of the school, teachers, and the learners to complete the study.
2.4.2 Orientation for the Participants
The researcher conducted a brief orientation session. During this session, the researcher took the opportunity to inform the participants, belonging to both the control and the experimental about the aims and objectives and purpose of the study.
2.4.3 Conducting of Pretest
After the orientation, a pretest was given for both control and experimental group. This was done before the intervention.
2.4.4 Intervention
The implementation began after the pretest. The researcher went to the school to carry out the study. By this time, the researcher had two groups the control and experimental group.
2.4.4.1 Control Group
The researcher had a discussion (using the traditional method) with the control group, covering the following topics: (i) illustrates an experiment, outcome, sample space, and event; (ii) count the number of occurrences of an outcome in an experiment: (a) table, (b) tree diagram, (c) systematic listing, and (d) fundamental counting principle; (iii) finds the probability of a simple event; (iv) illustrates an experimental probability and a theoretical probability; and (v) solves problems involving probabilities of simple events. In the control group, the traditional method of assessment "paper and pencil test" was given after the discussion of each competency.
2.4.4.2 Experimental Group (Flip the Tin Can Game with a Twist)

In conducting the game, an orientation was done first. The game was played after a discussion of each competency of the Basic Probability. The learners were grouped according to the mechanics of the game. In this game, each group was composed of five (5) members and was given three questions. Each group should match five (5) groups in order to earn the highest possible score, which is 15. Additionally, every group had a designated timekeeper responsible for monitoring the group's time while the opposing groups answered the question. Another member of the group was responsible for keeping the questionnaire and verifying the accuracy of answers provided by the opposing group. The researcher also served as a facilitator. After the game, discussions and explanations were done covering the same topics.

2.4.5 Conducting Posttest

After completing the intervention, the researcher had given the Grade 8 learners a posttest for both control and experimental groups. The same achievement test as the post test was administered to the participants after the implementation of the Flip the Tin Can Game with a Twist. To ensure the completion of the test by the participants, an advance announcement was made by their adviser.

2.5 Data Analysis

The data was analyzed using quantitative and qualitative research software analysis. RStudio and Stata programming was used for software in the analysis of the data that are descriptive in nature mainly the tabular presentation with mean and standard deviation and Paired T-test was used for deeper inferential analysis for difference between the pretest and posttest of achievement level mean scores of Grade 8 learners in Probability.

2.5.1 Descriptive Statistics

Simple Percentage. It is a part of a whole expressed in hundredths and was used to determine the first variable's frequencies and percentages.

The measure of Central Tendencies by Mean. The mean is the most commonly-used measure of central tendency. The mean is simply the sum of the values divided by the total number of items in the set. The mean is valid only for interval data or ratio data

Standard Deviation. The standard deviation represented the distribution of the responses around the mean. It indicated the degree of consistency among the responses. In conjunction with the mean, the standard deviation provides a better understanding of the data.

Coefficient of Variation. It is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation represents the ratio of standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from one another.

2.5.2 Inferential Statistics

It is described by using a random sample of data taken from a population to describe and make inferences about the population. Inferential statistics utilized in this study include Paired t-test.

Paired T-test. It is a statistical procedure used to determine whether the mean difference between two sets of observations is zero. In a paired sample t-test, each subject or entity is measured twice resulting in pairs of observation.

2.6 Coding of Qualitative Data

The researcher used the coding system to organize the qualitative responses. Each participant was given a letter and a number that correspond to one another. The participants in the control group were coded with the letter C and a number that corresponds to their names on the list. For instance, the first person on the list of control group participants was coded C1. On the other hand, the participants for the experimental group were coded using the letter R and a number that corresponds to their name on the list. For instance, the R1 code was assigned to the first participant in the experimental group list. Moreover, questions in the perception questionnaire were coded Q1, Q2, and so on.

3.0 Presentation, Analysis of Qualitative and Quantitative Data

The discussion highlights the results on the outcomes of analyzing leaners' performance in the Basic Probability achievement test, emphasizing the effect of the Flip the Tin Can Game with a Twist on learner's achievement levels. These results are further supported by qualitative data from the learners' perceptions which were collected through a questionnaire and supported by short interviews.

3.1 Achievement level

A researcher-made pretest was administered to the control and experimental group for the achievement test at the start of the study. The same test was used as posttest after the interventions were implemented. Both results were reflected in the Table 2

Table 2. Frequency Distribution of Learner's Achievement Level in Probability (n=98)

Score Range	Control Group				Experimental Group				Interpretation
	Pretest		Posttest		Pretest		Posttest		
	f	%	*f*	%	*f*	%	*f*	%	
21-25	0	0	4	8.16	0	0	7	14.29	Advance Proficient
19-20	0	0	9	18.37	0	0	8	16.33	Proficient
17-18	1	2.04	8	16.33	2	4.08	13	26.53	Approaching Proficient
15-16	1	2.04	13	26.53	2	4.08	10	20.41	Developing Proficient
14 and below	47	95.92	15	30.61	45	91.84	11	22.44	Beginning Proficient
Total	49	100	49	100	49	100	49	100	

Based on the table, the achievement level for the pretest control group shows that out of 49 respondents, 47 or 95.92% of learners were classified as beginning proficient, while 1 or 2.04% of learners were both approaching and developing proficient. This indicates that almost all learners in the control group were at the beginning proficient level for Grade 8 achievement in Probability. Observed that pretest of the control group showed varying results in the post-test. Specifically, the beginning proficient category comprised 30.61% or 15 learners, developing proficient had 26.53% or 13 learners, proficient accounted or 18.37% or 9 learners, and advance proficient represented 16.33% or 8 learners. This indicates that a majority of the learners initially fell into the beginning proficient category, although this proportion decreased compared to the pretest. Thus, there were notable shifts in achievement levels between the pretest and post-test, but the beginning proficient category still remain prevalent in the control group's post-test result.

This result is supported by the study conducted by Arum, et al. (2018), where based on the result of problem-solving activity and conducted interview, it turned out that the learners have difficulty in understanding probabilistic problems. This further leads to learner's error in identifying the unknown of the problem correctly which hinders them to understand the meaning of the question. It was related to the learners' text comprehension errors. Moreover, learner's difficulty in probability is due to the inability in understanding the meaning of the probabilistic problem. Thus, it emphasized the importance for mathematics teachers to plan probabilistic learning material that can optimize learners' probabilistic thinking skills. Selection of models, methods, strategies, techniques and learn media probabilistic material to minimize the learner's difficulties and errors in probabilistic problem-solving process.

While in the experimental group, out of 49 learners, 45 or 91.84% of learners were beginning proficient while 2 or 4.08% were both approaching and developing proficient respectively. This indicates that almost all of the learners in experimental group achieved a beginning proficient level on their pretest.

In a subsequent observation after the pretest, it was found that the pretest of experimental group there were major changes for the post-test. Approaching proficient had 26.53 % or 13 learners, developing proficient had 10 or 20.41% of learners, beginning proficient had 11 or 22.44 learners, advanced proficient had 7 or 14.29% and proficient had 8 learners or 16.33 %. This suggests that the majority of the learners were approaching proficient and developing proficiency and there was a decreased number of learners in the beginning proficient from the pre-test to post test. Therefore, there were notable shifts in achievement levels between pretest and post-test after the experiment since the development, approaching, advance and proficient had increased among the Grade 8 learners in Probability.

The increase of the result of the post-test of the experimental group can be associated with the type implementation of the game in the class. The study conducted by Hui & Mahmud (2023) demonstrated that Game-based learning (GBL) had positively impacted students when they are learning mathematics. The study revealed that GBL influences two cognitive domains, namely knowledge and mathematical skills, as well as five affective domains, including achievement, attitude, motivation, interest, and engagement. The findings of this study encouraged educators to employ GBL more effectively in classroom settings. It is now one of the major learning trends of the 21st century. Since 2019, studies relating to game-based learning have been increasing, demonstrating its influence on the cognitive and affective domains in T&L Mathematics.

3.2 Comparison of the Mean Score Difference in Achievement Level Within Group

The Paired t-test was used to determine whether there were significant differences in achievement levels within and between groups for pretest and post-test. This allowed for an assessment of whether the intervention had a significant impact on the participants' achievement levels over time.

Furthermore, the Paired t-test also facilitated a comparison of achievement levels within and between group

for the Control and Experimental groups. This comparison helped determine if there were any significant differences in the effectiveness of the intervention between the two groups.

Table 3. Mean Difference in Achievement Test Scores Within Group

Statistical Tool	Control Group		Experimental	
	Pretest	Posttest	Pretest	Posttest
Observation	49	49	49	49
Mean	10.18	16.10	10.06	17.04
Mean Difference	5.92		6.98	
Standard Deviation	2.48	3.32	3.59	3.18
p-value	0.0001**		0.0001**	

Note: Significant if p-value < 0.05* and p-value < 0.01**

As indicated by the information presented in Table 3, it can be observed that the control group had a pretest mean of 10.18 with a standard deviation of 2.48. The mean posttest for the control group was 16.10 with a standard deviation of 3.32. The difference between the pretest and posttest scores within the control group was 5.92. A Paired T-test result was conducted to examine if there was a statistically significant difference between the pretest and post-test for control group in terms of achievement level. In addition, there was a significant difference between the pretest and posttest for control group with the p-value less than 0.05. Therefore, the control group of pretest and post-test had a significant impact especially when we checked Table 5 indicates that the proportion of beginning proficiency decreased compared to the post-test but, the beginning proficient category remained prevalent in the control group's post-test result.

On the other hand, the experimental group exhibited a pre-test mean of 10.06 with a standard deviation of 3.59. The mean score of posttests was 17.04 with standard deviation of 3.18 The difference between the pre-test and post-test scores within the experimental group was 6.98. It follows that the conducted statistical test called Paired T-test which revealed that there is a significant difference between the pretest and postest scores of experimental groups. This indicates that there was a significant impact especially when we checked the Table 5 that the majority of the learners were approaching proficient and developing proficient and there was a decreased number of learners in the beginning proficient from the pre-test to post-test. Thus, there was a notable shift after the experiment using the flip the tin can game with a twist since the developing, approaching, advance and proficient had increased among the Grade 8 learners in Probability.

Ramli, Maat, & Khalid (2020) stated in their study that Game-Based Learning is seen to have many benefits in helping to improve the quality of the teaching and learning process in Mathematics learning. The researchers added that the GBL will encourage the learners to solve problems and develop self-learning which will 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. They concluded that GBL helps learner's achievement in Mathematics because while playing learners will apply basic math concepts and skills, reading skills, and problem-solving skills to ensure that assignments are completed. The *Flip the Tin Can Game with a Twist* used as an intervention in the experimental group is an example of a game-based learning approach.

By employing the same descriptive and inferential statistics, as well as conducting a Paired t-test, the table served as a reference for the researcher's investigation into the difference in the pre-test and post-test mean scores in the Achievement test between the control and experimental groups.

3.3 Comparison of the Mean Score Difference in Achievement Level Between Group

Table 4. Mean Difference in Achievement Test Scores Between Group

Statistical Tool	Pretest		Posttest	
	Control	Experimental	Control	Experimental
Observation	49	49	49	49
Mean	10.18	10.06	16.10	17.04
Mean Difference		0.12		0.94
Standard Deviation	2.48	3.58	3.32	3.19
p-value		0.8454e		0.1273

Note: Significant if p-value < 0.05* and p-value < 0.01**

Based on the Table 4, the mean score of the control group in the pretest was 10.18 with a standard deviation of 2.48. On the other hand, the mean score of the experimental pretest was 10.06 with standard deviation of 3.58.

The difference between the pretest scores of controls and experimental group was 0.12. Consequently, upon conducting Paired T-test the result shows that there was no significant difference between the pretest score

of the control and experimental groups, with a p-value of 0.8454. Therefore, the between-group pretest in control and experimental groups had no significant effect on the learners.

On the other hand, the control group's posttest mean score was 16.10 with a standard deviation of 3.32. The mean score for the experimental posttest was 17.04 with a standard deviation of 3.19. The difference between the post-test scores of the control and experimental groups was 0.94. However, upon comparing the post-test results between the control and experimental groups, there is no significant difference was observed. This conclusion is based on the comparison of the post-test scores of both groups, as the calculated p-value was found to be greater than 0.05.

However, based on the learners' perception of playing the "Flip the Tin game with a twist", it was found that the game is enjoyable and helps develop critical thinking skills. It makes mathematics a more interesting for learners as accompanied by the game. Additionally, this game provides a challenge as you need to find ways or solutions to problems to answer and increase your points in your group.

3.4 Perceptions on the Flip the Tin Can Game with a Twist.

To gather detailed information on what the participants thought of the Flip the Tin Can Game with a Twist, the researcher prepared five (5) questions for the respondent's interview. These were thoughtfully prepared to gather insights about the participants' experiences, opinions and perspective.

In addition, the learners in the experimental group were actively engaged in learning the topics, collaborated with one another, learned and explored mathematical concepts easily.

The following statements were recurring themes in the learner's responses to the perception questionnaire.

Learning Experience and Improvement

Seventeen (35%) of the total learners expressed their thoughts regarding the Flip the Tin Can Game with a Twist. The learners acknowledged that this particular game posed certain difficulties or challenges. However, despite these challenges, they found that playing the Flip the Tin Can Fame with a Twist helped them learn more about probability and enhance their mathematical skills.

"This game has helped me learn more about probability". R1

"I enjoy the game, and it has been incredibly helpful in improving my understanding of probability. This game has significantly enhanced my mathematical skills". R5

"The game has been a great help to me, especially when it comes to my math lessons and exams. Through this game, I have learned a lot and gained a deeper understanding of mathematical concepts. This game also brings joy and fun." R12

-R48

The learners enjoyed and had fun playing the Flip the Tin Game with a Twist while learning probability at the same time.

Sixteen (32%) of the total learners expressed their thoughts regarding the Flip the Tin Can Game with a Twist. The learners acknowledged that this particular game posed certain difficulties or challenges. However, despite these challenges, they found it enjoyable and they had a great deal of fun while participating in it. Here are some selected responses from the learners, showcasing their enthusiasm and excitement during the activities.

*"*It's very enjoyable and you ca learn a lot." **R14**

-R37

"The game helped me learn lessons related to probability. Although flipping the can be challenging, it is also incredibly enjoyable" **R43**

"I learned a lot from playing flip the tin can game with a twist, especially in solving probability. I had fun and enjoyed the game, and I learned while playing. " **R49**

Based on the learners' responds, it is clear that the game not just facilitated their learning of probability but also provided a significant amount of enjoyment and fun. Al-Azawi, Al-Faliti, & Al-Blushi (2016) claimed that games give learners a venue for their creativity to express themselves and make subjects to learn enjoyable.
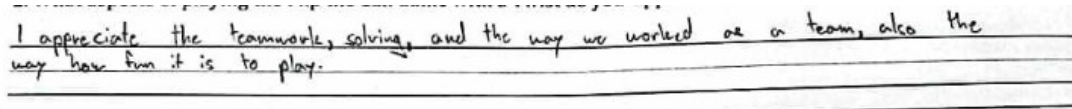
The learners appreciate the game because it promotes teamwork collaboration.

The game was found to promote teamwork and collaboration and enhance problem solving abilities by 7 or (15%) participants. According to some learners, teamwork allows them to answer the activity more effectively as they can share ideas. Others pointed out that teamwork makes the activity significantly easier since there are more individuals working together to solve the activities, enabling the sharing of solutions and quickly identifying the correct answer.

"I appreciate the teamwork and problem-solving skills we demonstrated as a team." ***R15***
*"I appreciate the collaborative effort of my groupmates in helping to answer the questions. Their support and teamwork have been invaluable in tackling the challenges."****R3***

-R13

The learners' responses indicate that through the game they are able to appreciate the collaborative effort of their teams. They appreciated the importance of collaboration of the group to be able to overcome the difficulty they experienced in answering the problem. According to Zhong, Q. (2019), the game-based learning concept is applied in the teaching process of collaborative learning. The researcher concluded that imparting and internalization of knowledge are accomplished through classroom games. The use of game-based learning method enables students to complete their learning in a relaxed and pleasant environment, and improves their self-team awareness and collaborative ability.

Challenges or obstacle

However, despite the advantages provide by the learners, there were six or (13%) who experience several challenges and difficulties during their experience with the "Flip the Tin Can Game with a Twist". The following are some of the challenges and difficulties by the learners:

a. **Difficulties in Flipping the Tin Can**
"It is difficult to flip the tin can when it is on the floor." ***R9***
"When flipping, it can be challenging if the hand starts shaking, making it difficult to execute the flip.***"R37***

b. **Time Pressure.**
*"One of the challenges we have experienced is time pressure because we need to hurry to avoid running out of time."****R40***

c. **Disagreement and Difficulty in Answering Problem**
"Ang challenge na amo na encouter kay kanang questions na lisod og dili magkasinabot." ***R20***

Flip the Tin Can Game with a Twist has helped them develop problem-solving and math skills

The responses of the learners, approximately 2 or (5 %) that playing the Flip the Can Game with a Twist has helped them develop and acquire various abilities and competencies, with a particular focus on problem-solving and math skills.

"I developed problem-solving abilities through playing the game." ***R13***
"The game improved my ability to solve probability problems more efficiently and rapidly.***"R35***

The participants responses expressed that they are able to develop problem-solving skills through the game. Through this, they are able to learn the concept and analyze mathematical problem. According to Liu, T. and Israel, M. (2021), as cited by Kailani, Newton, & Pedersen (2019) the game-based learning has emerged as powerful and effective context for nurturing students' problem-solving skills.

4.0 Summary of Findings, Conclusions and Recommendations
4.1 Summary of Findings

After thoroughly analyzing and interpreting the gathered data, the researcher of this study formulated the following statements to summarize the findings and present the results below:

1. The achievement levels of Grade 8 learners in both control and experimental groups were initially categorized as beginning proficient. Yes, in the posttest, however, significant changes were observed.

The control group reached the level of developing proficient, while the experimental group obtained the level of approaching proficient.

2. The comparison of the achievement level within the control and experimental groups revealed that there was a significant difference between the pre-test and post--test. However, when compared, there was no significant difference between the pre and post-test of both control and experimental groups.

3. Learners' perceptions of the Flip the Tin Can Game with a Twist were generally positive.

4.2 Conclusions

Based on the findings of the study, the following conclusions were drawn.

1. The achievement level of both groups in the prest and post-test were categorized as a beginning level. This suggests that the learners had lack of prior knowledge and experience with probability. However, there was an increase in their mean scores for post-test in both groups after the intervention. The implementation of the "Flip the Tin Can Game with a Twist" has a significant increase in the achievement levels of the experimental group.

2. The between-group reveals no significant differences in achievement test scores between the Control and Experimental groups. However, the within-group showed significant improvements in achievement test scores within both the Control and Experimental groups. This suggests that the intervention had a positive impact on the participants' achievement levels, but the differences between the two groups were not statistically significant.

3. In conclusion, in the perception of the learners on the "Flip the Tin Can Game with a Twist" was predominantly positive and highlighted the effectivity of the game for learning and improving their understanding of probability. Learners expressed that the game helped them learn more about probability and enhanced their mathematical skills, providing a valuable learning experience.

4.3 Recommendations

Based on the findings, the following recommendations can be made:

1. Based on the responses of the learners' perception of the Flip the Tin Can Game with a Twist in Probability had a positive perception of the game. They found the game enjoyable, fun and challenging. It may be used as an activity in learning mathematics concepts.

2. Educators and curriculum designers should consider integrating game-based approaches, such as the Flip the Tin Can Game, into Probability lessons for Grade 8 learners. This can enhance and increase learner's engagement in the subject.

3. For the future researchers recommended that they develop other games for learning probability or other mathematics topics. In addition, they could also explore the long-term effects of game-based approaches on learners' achievement levels and engagement in Probability and other subject areas.

4. Incorporating game-based assessments is a useful way to evaluate learners' capabilities in a subject. It not only effectiveness their understanding of the content but also provides the added advantage of the enjoyable learning experience.

5. School administrators should encourage teachers to develop learning materials that make use of the ease and advantages of Flip the Tin Game with a Twist in teaching mathematics at all levels.

References

Anggraini, S., & Kusrini, E. (2018). The Analysis of Students' Difficulties in Solving. *Advances in Social Science, Education and Humanities Research (ASSEHR), volume 160*, 166-169. Retrieved from https://www.atlantis-press.com/proceedings/incomed-17/25893819

Antonio, J. M., & Tamban, V. E. (2022). Effectiveness of Gamification on Learner's Performance and Attitude towards Mathematics Amidst the COVID19 Pandemic. *United International Journal for Research & Technology*, 91-100. Retrieved from https://uijrt.com/articles/v3/i3/UIJRTV3I30013.pdf

Arum, D. P., Kausmayadi, T., & Pramudya, I. (2018). Students' Difficulties in Probabilistic Problem-Solving. *Journal of Physics: Conference Series*, 1-6. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/983/1/012098/pdf

Gafoor, K., & Kurukkan, A. (2015). Why High School Students Feel Mathematics Difficult? An Exploration of Affective Beliefs. 2. Retrieved from https://files.eric.ed.gov/fulltext/ED560266.pdf

Hui, H. B., & Mahmud, M. (2023). Influence Of Game-Based Learning In Mathematics Education On The Students' Cognitive And Affective Domain: A Systematic Review. *Fronties*. Retrieved October 30, 2023

Kelly, M. (2017, May 17). *Probability + Bottle Flipping = Fun Learning!* Retrieved from I ❤ EDU: https://www.i-heart-edu.com/probability-bottle-flipping-fun-learning/

Liu, T., & Maya, I. (2022). Uncovering students' problem-solving processes in game-based learning environments. Computers & Education. doi:https://doi.org/10.1016/j.compedu.2022.104462

Magsambol. (2020, December 9). *PH lowest among 58 countries in math, science – global assessment*. Retrieved from Rappler Bonz: https://www.rappler.com/nation/filipino-students-lagging-behind-math-science-timms-international-results-2019/

Mazana, M. Y., Montero, C. S., & Casmir, R. (2020). Assessing Students' Performance in Mathematics in Tanzania: The Teacher's Perspective. *International Electronic Journal of Mathematics Education*, 2-28. Retrieved from https://eric.ed.gov/?id=EJ1254834

Nurnberger-Haag, J., Wernet, J. L., & Benjamin , J. I. (2023). Gameplay in Perspective: Applications of a Conceptual Framework to Analyze Features of Mathematics Classroom Games in Consideration of Students' Experiences . *International Journal of Education in Mathematics, Science, and Technology* , 267-303. Retrieved from https://eric.ed.gov/?id=EJ1357378

Ramli, I. S., Maat, S., & Khalid, F. (2020). Game-Based Learning and Student Motivation in. *International Journal of Academic Research in Progressive Education and*, 449-453. doi:DOI:10.6007/IJARPED/v9-i2/7487

Rutherford, K. (2015, April 27). *Why Math Games are Important*. Retrieved from Mathnasium: https://www.mathnasium.com/blog/why-math-games-are-important#:~:text=Games%20give%20students%20opportunities%20to,and%20other%20important%20mathematical%20concepts.

Zhong, Q. (2019). Design of Game-Based Collaborative Learning Model. *Open Journal of Social Sciences*. doi:10.4236/jss.2019.77039