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Research Article

Enriching the Teaching of Pie Chart Using Cooperative Learning as a Strategy: A Quasi-Experimental Research

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Abstract

There is myriad of strategies that can be employed in the classroom. One of these is the Cooperative Learning. Because cooperative learning is a common strategy, it will just be used in different topics without considering its effectiveness in a particular topic. Thus, little attention is given to test how effective this strategy is. This study endeavored to assess if cooperative learning can make the discussion of pie chart an engaging one. The study used Quasi-Experimental research design in fulfilling its objectives. The respondents are grade 6 learners studying at Langin Elementary School in Ronda, Cebu, Philippines. There are 30 respondents in total in both control (15) and experimental (15). The experimental group garnered the mean of 11.47 and the control group mean with 9 in the pretest. While in the posttest, the experimental group garnered 19.33 and the control group landed on 17.60. With the 0.05 significance level, the results between the pretest and posttest of the two groups were found to be significant (p-value= 0.00). This is a realization that strategies can possibly constitute a significant difference. In this study, both the traditional way of teaching the topic and the one that is being introduced marked significantly. Thus, it is recommended to have this strategy tested in different topics in Mathematics and other subjects wherein the findings of this study can be verified.

Keywords: Cooperative Learning, Enriched Teaching-learning process, Pie Chart, Quasi-experimental, Philippines

Introduction

Mathematics is one of the core subjects in the elementary years among children and yet most of the skills are not well mastered. In this time of the pandemic, mathematics is communicated to the learners through modular instruction. Mathematics education, especially the learners in grade 6 level is facing challenges. The National Assessment of Educational Progress in the United States (NAEP) found that math students in the middle grades did not perform at the baseline competency level that they should have been, with some children approaching but not quite reaching proficiency levels. They keep performing below the NAEP-set standard in terms of math subject. Little to no attention was given to testing different strategies in order to improve the teaching-learning process especially in enriching the discussion of the pie chart. This study assessed cooperative learning by providing an engaging discussion of the subject matter.

According to research, cooperative learning can help students participate more actively, increase student achievement in mathematics (Artzt & Yaloz-Femia, 1999; Webb, 1991) and encourage favorable attitudes toward learning mathematics (Leikin & Zaslavsky, 1997). These techniques were recognized as the most successful in boosting the mathematical achievement of all pupils, particularly middle-school kids. Although there is indication that these tactics have resulted in academic accomplishment across all grade levels and subject areas, cooperative learning approaches to mathematics learning, in especially, seem to closely match to the learning processes of middle-school pupils. Due to their individual and interpersonal learning perspectives, middle-grade children gain the most from cooperative learning practices (Slavin,1999). The student's achievement is tied to their inclination for exploration, creativity, and harmonic connection with those in their learning contexts. Cooperative learning in mathematics provides for a more effective learning environment. It creates a learner-centered environment and takes students away from the typical inactive method of learning which is common in math courses. Cooperative learning in Middle Math encourages students to listen to each other and, exchange ideas, and challenge one another's thinking. The application of this method helps pupils to engage in higher-level thinking and inquiry.

The main topics of study in mathematics are quantity,

structure, space, and change. By rigorously deducing conclusions from a small set of definitions and axioms, mathematicians look for patterns, formulate novel hypotheses, and establish the truth. Learning about mathematics begins as early as kindergarten. There are numerous ways to teach the concepts covered in this course. One of the methods is cooperative learning, a form of instruction that involves putting students in small groups according to their degree of aptitude. This strategy makes use of a range of learning activities to improve the student's understanding of the material. One of the teaching strategies that has the most theoretical support, is employed frequently and is also one of the most misunderstood (Igel, 2010).

A determined effort must be made to teach the interpersonal and small group skills necessary for effective collaboration, in addition to structuring the learning or problem-solving assignment so that the learners are connected in a way that no one can succeed until they all do. The study of mathematics is a requirement for graduation from high school and is crucial for both daily life and other academic pursuits (Gafoor & Kurukkan, 2015). Cooperative learning, however, revealed the students' reluctance to acquire mathematics (Curtis, 2006). Out of 82 Malaysian respondents, 44 participated in the experiment, whereas 38 were in the control group, as indicated by Daud et al. (2010) investigation of understudies' post-test math execution. The outcomes showed tremendous contrast in comparison to the mean execution scores of exploratory as well as control at an alpha degree of 0.05. It proved that, when compared to conventional instruction, the cooperative learning approach achieved greater academic achievement.

Likewise, as per examination by Antolin et al. (2017), the understudies' number-related capacity further developed after getting guidance utilizing the agreeable learning approach, moving toward capability. The outcomes showed that the experimental group and control group really showed essentially unique execution. Based on the results of the control group, which used a chalk and talk technique, whereas experimental group used cooperative learning. This study enables the teachers to identify the appropriate strategy to be used in teaching pie graphs as one of the topics in Grade 6. With numerous strategies available, cooperative learning was chosen to be tested if it is effective in discussing the chosen topic. The results of this study can be used by school administrators to justify the continued use of traditional teaching or to introduce cooperative learning in teaching math topics. If the strategy is proven to be effective, this study can be replicated in other schools to further validate the results. Not all kids can work together in groups to learn, and not all educators are adept at using the best practices when designing cooperative learning activities.

The cooperative spirit and social abilities necessary for society can be developed by students with the assistance of cooperative learning, but teachers must know how to use the method effectively (Willis, 2007). Many research studies show that math is a subject frequently taught solely through lectures and the traditional chalk and talk because it is a teacher-centered instruction by its nature that encourages pupils' passivity and isolation (Stephan, 2020; Doerr & Tinto, 2000). This study delved into the use of a cooperative learning strategy in discussing pie settings can use cooperative learning to teach math (Artut, 2009). To teach Mathematics in preschools, cooperative learning might be used. After being exposed to cooperative learning, Artut discovered that kids were more likely to share, cooperate, and pay attention to the teacher's instructions. They are also discovered to be more accountable. Further, this inquiry will answer the gap in the literature which is essential in making math an interesting subject.

This study investigated how well cooperative learning may be used to teach mathematics, which could have a considerable impact on students' learning. The study's goal is to ascertain how well cooperative learning functions when discussing pie graphs with sixth graders. Therefore, teachers in schools, particularly those who teach benefit from and significance of cooperative learning, thereby shifting from the teacher-centered to student-centered teaching technique.

Research Questions

This study determined the effectiveness of cooperative learning as a strategy in teaching pie charts to sixth graders. In addition, this survey provided relevant information that responds to the following queries:

1. What is the result of the pre-test for the two groups of respondents?
   1.1. Experiment Group
   1.2. Controlled Group
2. What is the post-test result for the two groups of respondents?
   2.1. Experiment Group
   2.2. Controlled Group
3. Is there a significant difference in comparison to the pre-test and post-test scores of the controlled and experimental groups?

Literature Review

This section contains numerous important pieces of related literature that will give strong proof about the implication and applicability of the research study. The researchers meticulously selected the published articles in different publications of high refereed and scholarly journals, and academic-generated articles based on the standard guidelines on literature review.

Student Teams Achievement Division (STAD) is one of the cooperative learning systems where students are taught to form groups of four or five people, each of whom represents a distinct gender and skill set. After the teacher teaches a lesson, the students work in each group to make sure that everyone has understood the material. Students must then complete assessments using the resources provided and work independently without assistance from other. The STAD model of cooperative learning and students' collaboration with the teacher is improved. It also increases pupils' performance and problem-solving abilities on a constant basis. Cooperative learning is intended to help students not only tackle difficult mathematics problems but also deal with the difficulties of daily living.

The STAD, cooperative learning approach has been thoroughly investigated and evaluated especially on academic accomplishments, attitudes, social interactions, and interpersonal connections (Kagan 1994; Johnson & Johnson, 1998; Johnson et al., 1999; Balfakih, 2003; Bernaus & Gardner, 2008; Tarim & Akdeniz, 2008). STAD is one of the simplest and most well investigated cooperative learning approaches, and it might be a good place to start for teachers who are new to the cooperative learning methodology (Slavin, 1990; Becker & Watts, 1998). STAD, often known as "student team learning," is a teaching approach developed and explored by Johns Hopkins University (Sharan, 1995). STAD as a teaching strategy has been studied and used successfully in a variety of research initiatives (Vaughan, 2002; Jacobs et al., 2003; Van Wyk, 2010).

It should be highlighted, nevertheless, that math teachers would have several difficulties in including cooperative learning in the classroom. For instance, a teacher might create fresh educational materials. They will also need additional time to adjust to the new method. Furthermore, supervising group activities may be challenging for certain educators. By giving in-service instructors thorough training and activities, these problems could be resolved (Zakaria & Ikhsan, 2007). Cooperative learning modules will be developed and made available by the Ministry of Education to lessen the burden on teachers who desire to employ this technique.

To create a successful math teaching and learning session, Lasvani & Khandan (2011) suggested that reevaluating effective teaching techniques is essential. The Ministry of Education of Malaysia (2002) claim that when designing teaching and learning activities, teachers should encourage student engagement, pique students' interests, consider their preferred learning styles, and cater to the range of intelligent present in the class. Oluwasanmi (2012) claimed that cooperative learning has been shown to boost pupils' motivation to learn. Additionally, they are more confident in themselves and may behave riskier less frequently. Additionally, according to Prabowo & Sonaryo (2015), in cooperative learning, the STAD method of curriculum analysis has been found to be effective. STAD and math learning material courses have higher levels of student engagement. They engage in group activities more so than in the classroom. This indicates that STAD could be used in terms of cooperative learning.

On the other hand, based on the research of Mohammadjani & Tonkaboni (2012), Cooperative learning and lecture-based instruction were compared for their effectiveness in fostering student understanding and satisfaction. In the investigation, fourth graders were identified as the respondents. The primary school housed 120 pupils (60 females and males). The research indicates that compared to lecture teaching, the teaching strategy of cooperative learning is more effective in improving student learning. Additionally, compared to their male counterparts, female students expressed greater satisfaction with their learning levels in the cooperative learning teaching style.

Moreover, Orprayoon (2014) explored how cooperative learning affected junior students' academic performance and collaborative skills in a course on current French literature. At the 0.01 statistical level, in relation between the Post-test and Pre-test outcomes revealed a substantial improvement in learning achievement for students adopting the cooperative learning technique. Additionally, Gubba (2010) found a comparable research outcome when he looked at how cooperative learning affected academic achievement. In Holy Makkha, Saudi Arabia, sixth-graders at a primary school were requested to recall the math. The average scores of the two groups in terms of their performance and memory level were

shown to be statistically significantly different by 0.05. Collaborative learning is more effective than traditional approaches in both respects, according to Capar & Tarim's (2015) work on the impact of collaborative learning methods on mathematical performance and attitudes.

As being said, the effectiveness of the teaching-learning process relies on the significant bearing of a strategy such as cooperative learning. To succeed in mathematics education, teachers must also be knowledgeable about a variety of teaching techniques so that they can build their strategies on this knowledge. At each academic level, students must gain a strong comprehension of the proper mathematical ideas and methods, according to all the teachers, who agreed that teaching and learning mathematics is a continual process. Teachers should encourage their students to explore their mathematical puzzles and use critical thinking to solve them as well as other difficulties in their daily lives.

During this time of the pandemic, doing research on a specific strategy is vital (Perez, et al., 2022). Teachers should find a remedy for how to deliver quality instruction in modular instruction (Cabello, 2022; Riconalla et al., 2022). At times, students procrastinate (Olleras et al., 02022) because of losing interest in the subject matter, especially Mathematics. A cooperative learning strategy can ignite the interest of the students to share their knowledge regarding the topic. However, during this time, parents are the ones accomplishing the tasks (Abucejo et al., 2022) of the students, especially in Math problem-solving. If the students are having challenges in understanding math problems, they can take advantage of the online resources if they have strong internet connectivity (Bahinting et al., 2022). Learners should continue learning even if the unprecedented event – Coronavirus - hinders the quality of education being forwarded to them (Ando et al., 2022). This study can be a manifestation that there's always a way to deliver a topic in the most engaging way possible.

Therefore, in circumstance, teachers require training and ongoing professional development, and collaboration among teachers should be fostered through the hosting of frequent formal and informal meetings. Teachers may learn from one another, assess the strengths and flaws of the education that has been applied, and share their experiences to generate better work (Ling et al., 2016). Furthermore, STAD cooperative learning application should be assessed in terms of each teacher's expertise and skills for better learning and teaching process.

Methodology

This study used a quasi-experimental research design. This method is essential for conducting action research to allow proper placement and management of the control and experimental group under test which is to assess the effectiveness of the strategy. The two groups complete the pre-test and post-test. The control group used chalk and talk as a traditional way of teaching the topic, while the experimental group used the cooperative learning method. The Statistics Package for Social Sciences' weighted mean and two-tailed T-test will be used in the investigation (SPSS).

Respondents

There will be 30 pupils from grade six of the same section. The controlled group and the experimental group were equally distributed to 15 respondents each. The respondents were the top 30 pupils in the class.

Instruments

The study used the Statistics Package for Social Sciences' Weighted Mean and Two-Tailed T-test (SPSS).

Weighted Mean

The weighted mean will be used to describe the pretest and post-test results.

Two-tailed T-test

The two-tailed t-test is widely used in establishing critical points of a distribution area whether a sample is greater than or less than a certain range of values. This is also used in proving the acceptance and rejection of the null hypothesis. This can also be used in the different statistical analyses comparing two sets of values.

Data Collection

A letter of communication was written and submitted for approval to the school principal's office. After the letter has been approved, the researchers asked permission from the respondents to take part in the study. The invitation is intended to be given voluntarily, free from any threats, or exchanged with accommodations for a prospective grade. The study's ethics adhered strictly followed. After receiving the confirmation of agreement from the respondents, the researchers divided the respondents appropriately. Each group consisted of 15 pupils or respondents.

After which, the pre-test was conducted. The researchers created the pre-test, which was tested through face validity and content validity assessment (Cabello & Bonotan, 2021). The researchers employed the design and validation method created by Colton & Covert (2007). The controlled group learned the topic Pie Graph using conventional method whereas, the experimental group was exposed to cooperative learning as a learning strategy. After then, the administration of the post-test commenced. The appropriate statistical tests chosen for this investigation was applied after the collection of the data. A flow chart was created to have a clear picture on how the gathering of data be conducted.

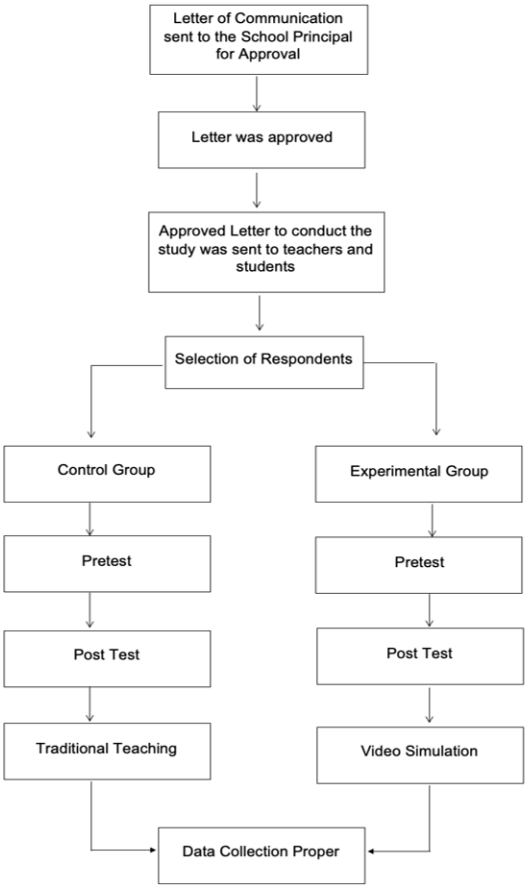

Figure 1. *Data Collection Flowchart*

Ethical Issues

Throughout the conduct of the study, the researcher followed moral guidelines. Throughout the study, the researcher exhibited the highest degree of objectivity in the discussions and interpretation of the results. This study acknowledged the usage of other authors works in all published articles that were highly refereed and used APA referencing style. To guarantee that the participants full consent was received, the researchers explained the study's goals and purpose of data gathering before collecting consent. The researchers noted that protecting the confidentiality, identity, and dignity of the study participants is of the utmost importance. In addition, it demonstrates a lack of respect for participants by ignoring their privacy and self-determination (American Psychological Association, 2012).

Results and Discussion

This part answered the research questions set in this study with discussions and substantiation from the different peer-reviewed articles.

Research Question #1

1. What was the outcome of the pre-test for the two groups of participants?
   1.1. Controlled Group
   1.2. Experimental Group

Table 1. *Pretest Results of the Two Groups*

Respondents	*Pretest (Controlled Group)*	*Pretest (Experimental Group)*
1	9	11
2	9	13
3	8	12
4	9	11
5	9	11
6	8	12
7.	9	13
8.	9	11
9.	8	12
10.	10	13
11.	8	11
12.	9	10
13.	10	10
14.	10	12
15.	10	10
Mean	9	11.47
SD	0.76	1.06

Table 1 contains the outcomes of both control and experimental groups. The result stipulated that the highest score garnered in the control group was 10 and the lowest score is 8 with an overall average of 9 and a standard deviation of 0.76. Meanwhile, the

experimental group got 13 as their highest garnered score and 10 as their lowest with a mean and standard deviation of 11.47 and 1.06 respectively. This suggests that the students lack expertise about pie graphs based on the two groups' results. Throughout the academic year, it is discovered that studying mathematics is difficult, which is a common and serious issue.

The Philippines performed significantly worse than other countries in the development of international mathematics and science research for fourth-grade mathematics and science (Magsambol, 2020). Despite the teacher's efforts to explain how the students should approach the activities because mathematics is believed to be a tough topic, the student's achievement was only moderate (Adora, 2015). The study of Hmelo-Silver (2004) supported this claim by highlighting that prior knowledge of a certain topic can be of great help to learners to understand a complex concept. The outcomes for the two groups showed that these students only had a basic understanding of the subject of pie graphs.

This database can be used to assess the type of intervention that the researchers ought to use in order to fill the gap. To properly elaborate on the issue, it is important to use a variety of instructional methodologies and strategies. In this manner, students can comprehend and assimilate difficult ideas that can aid in the concretization of their knowledge of the subject.

Research Question # 2

2. What is the post-test result of the two groups of respondents?
   2.1 Controlled Group
   2.2. Experimental Group

Table 2. *The Posttest Results of the Two Groups*

Respondents	*Posttest (Controlled Group)*	*Posttest (Experimental Group)*
1	18	20
2	16	18
3	20	16
4	16	20
5	20	20
6	18	20
7.	18	18
8.	16	20
9.	18	20
10.	14	20
11.	16	20
12.	20	18
13.	16	20
14.	20	20
15.	18	20
Mean	17. 60	19.33
SD	1.88	1.23

Table 2 contains information on the test outcomes for the control and experimental groups using the traditional way of learning and the cooperative learning technique. The results show that the control group's mean is 17.60, its standard deviation is 1.88, and its greatest and lowest scores range from 20 to 15. On the other hand, the data of the experimental group presented that their highest score is 20 and their lowest score is 18 with a mean of 19.33 and 1.23 as their standard deviation respectively. With this, it is observed that the experimental group manifested progress with their academic performance using cooperative learning as an instructional strategy being utilized during the discussion.

The findings suggested that peer learning can significantly increase comprehension as the experimental group received nearly flawless scores compared to the controlling group. With this, the claim that the level of understanding a learner can get from the new strategy being utilized especially student engagement strategy can improve the student's academic achievement and attitude towards learning. Students' academic performance, interpersonal skills, and working mindset are all improved by cooperative learning (Chen, 2018; Johnson & Johnson, 2008). It can be inferred that using the new technique differed slightly from using the conventional method of instruction. Cooperative learning may be a more effective approach for teachers to use in order to raise student performance (Harman & Nguyen, 2010).

The difference, however, is so insignificant that

learning was effectively distributed equally between the experimental and control groups. It is crucial that schools teach pupils more than just arithmetic; they must also teach them how to work well in teams. With this, the new technique marks a greater level of learning for the students during the debate of this subject.

Research Question #3

3. Is there a significant difference between the pre-test and post-test scores of the controlled and experimental groups?

Table 3. *Pretest and Posttest Difference between Controlled Group and Experimental Group*|

Group	*n*	*df*	*t-value*	*p-value*	*Alpha*	*Interpretation*	*Remarks*
Controlled Group	15	14	15.39	.00	0.05	Significant	Reject the Null Hypothesis
Experimental Group	15	14	16.50	.00	0.05	Significant	Reject the Null Hypothesis

Table 3 displays the major variations between control and experimental groups' pre-test and post-test outcomes. The table underlines that the test scores of the two groups differ significantly, which is why both participant ratings from the two groups demonstrate a significant difference.

Cooperative learning is regarded as one of the major elements that contribute to students' success (Sapon-Shevin, 1994). Teachers assist students become problem solvers who are willing to go out and find the answer rather than expecting someone to deliver it to them by teaching them how to work together and to use one another's knowledge. There is substantial evidence, according to Johnson & Johnson (1986), that learners who work in collaborative band create higher levels of cognition and retain information longer than those who study silently alone. Through shared learning, students may participate in debates, take charge of their own education, and hone their critical thinking abilities (Lin, 2006; Shen & Qiang, 2002; Chen & Cheng, 2004). Although students learn the most in a short amount of time, teachers play a major part in the traditional teaching approach.

The results of the pretests and posttests for both groups were significantly different, as shown in the table. This implies that students who take the test prepared with the essential knowledge have attained the same level of understanding as those who took the test using both the old and new procedures. The table also implied that in terms of how the subject was presented, both effectively explained it in a way that the learner could grasp.

Conclusion

The cooperative and traditional ways of learning were utilized in discussing pie graphs among Grade 6 learners. The study showed that the cooperative learning strategy established significant differences, as well as the traditional way of learning too. Thus, cooperative teaching can be a great tool for discussing pie graphs. It can also be applied to teach various topics. The purpose of this study was to determine the efficacy of the cooperative learning strategy in discussing pie graphs.

The study's findings led to the following recommendations: Curriculum guidelines for all instructors may be enhanced with an emphasis on teaching and the learning process, and the cooperative learning technique might be included into difficult topics. To avoid kids' issues with fundamental mathematical abilities, school administrators should focus on remediation programs and instructional intervention plans. Based on prior studies, future researchers may undertake comparable studies with new topics or respondents who have distinct characteristics.

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