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Effectiveness of Cooperative Learning On the Academic Performance in Mathematics of Junior High School Students in the Philippines

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Abstract: -

Background/Objectives: Cooperative learning is a potential strategy for Mathematics instruction. The study aimed to determine the effectiveness of cooperative learning on academic performance in mathematics for junior high school students.

Methods/Statistical analysis: The study used a quasi-experimental research design. The study respondents were grade 9 and grade 10 students of Bamban National High School, Masinloc, Zambales, Philippines. The research instrument is in the form of pre-test and post-test. The data gathered was tabulated for statistical treatment, analysis and interpretation using Frequency and Percentage Distribution, Weighted Mean, Pearson r Correlation Analysis, and T-test.

Findings: The findings reveal that the academic Performance in Mathematics of the respondents from grade 9 and grade 10 are both satisfactory. The respondents' level of Performance during the pre-test did not meet expectations for both grade 9 and grade 10. In contrast, the respondents' level of Performance after using cooperative learning is both satisfactory for grade 9 and grade 10. The computed significance value for grade 9 and grade 10 indicates a significant relationship between the respondents' academic Performance in Mathematics and pre-test level of Performance. Also, there was a significant relationship between the respondents' academic performance in Mathematics and post-test level of Performance. Both grade 9 and grade 10 students were found to have a significant difference in performance level on pre-test and post-test after using cooperative learning as intervention.

Improvements/Applications: The study's findings will provide insights into how to improve their classroom teaching practices.

Keywords: Academic Performance, Cooperative Learning, Effectiveness, Mathematics, Strategy

1. Introduction

Mathematics has continually been regarded as a difficult and much less exciting subject by students. Through the years, teachers confronted issues motivating and engaging the students in mathematics class. However, mathematics is considered one of the important subjects in school education (Hojjat et al., 2015). According to

Ahmad T., Rohani & Bayat, Sahar (2012), improvements have been made to the mathematics curriculum used in schools and institutes of higher learning, such as the requirement that students be able to create more complex, abstract, and powerful mathematical structures in order to address a wide range of significant real-life situations. Actual observations and practical experience with math teachers demonstrate that kids' interest in mathematics decreases as they progress through school despite new teaching and studying mathematics guidelines and formative effects (Mihaela & Monica, 2014).

Parental practices on children's mathematical achievement are much stronger in most Asian countries (Wei & Dzeng, 2014). In the Philippines, a study conducted by Sangcap (2010) revealed that Filipino college students think that putting out effort can improve one's mathematical skills and that mathematics is useful. According to the Mathematics Framework for Philippine Basic Education by SEI-DOST & MATHTED (2011), students will not learn by merely seeing a teacher solve problems on the board and in order to optimize their learning potential, students must take responsibility for being actively engaged by participating in discussions, ask questions, argue, and reasons so that they may see many aspects of mathematics that they are learning.

Cooperative learning has evolved as a major new approach to classroom instruction during the last decade (Bahman, 2014). Faculty members from various educational areas use cooperative learning exercises as part of their teaching strategies (Tisha L.N. et al.,2016). As compared to other traditional teaching methods, Cooperative learning is more effective at improving students' awareness, interpersonal skills, and motivation. The study of Valdez et al. (2015) showed that students become more involved in the learning process according to their pace and freedom of participation because of cooperative learning. Furthermore, the study also revealed that the strategy is very effective for improving students' ability to think and avoiding misconceptions of ideas that may arise if teachers continue to teach in the traditional strategy.

Cooperative learning is one of the many ways for effective mathematics teaching. Whether in an educational context, students have always learnt by actively interacting with their surroundings. Learners who study mathematics under the guidance of experienced teachers will be able to perform basic calculations and be far ahead in their knowledge and preparedness for higher mathematics. To achieve educators' goals of developing proficient individuals who will lead the next generation, innovative teaching strategies such as cooperative learning must be established. Utilization of the said strategy will advance through identifying the effects it can cause in students' academic Performance, specifically in mathematics, hence this study.

The study's findings will be utilized as a benchmark for developing instructional methods and strategies, specifically cooperative learning strategies. It will help inspire teachers to develop and use other teaching strategies and the traditional ones. It would also enhance students learning, specifically in the subject of mathematics, because they are the ones who are immediately impacted by the teachers' strategies in teaching. Finally, the findings can be used as records and a basis for further research.

2. Objectives of the Study

This study aimed to determine the effectiveness of cooperative learning on the academic Performance in Mathematics of grade 9 and 10 students.

Specifically, it answered the following questions:

1. What is the academic Performance of the respondents in Mathematics?
2. How the Performance of the students is be described during pre-test?
3. How the Performance of the students is be described after using cooperative learning?
4. Is there a significant relationship between the respondents' academic performance in Mathematics and Performance during pre – test?
5. Is there a significant relationship between the respondents' academic performance in Mathematics and Performance after cooperative learning?
6. Is there a significant difference in the respondents' academic performance in pre–test and post-test?

3. Related Work

The basic goal of teaching at any level of education is to create fundamental change in the learner (Tebabal & Kahssay, 2011). In order to address issues that students face in the subject of mathematics, teachers should come up with appropriate teaching strategies that best suit the subject. According to Khan and Innamullah (2011), Cooperative learning is practices used by educators to assist students develop necessary social skills. It is a method that allows students to work in pairs or groups to tackle a problem (Razak, 2016).

In the study conducted by Gul & Shehzad (2015) entitled, "Effects of Cooperative Learning on Students' Academic Achievement", the results revealed a significant difference in scores between the experimental and control groups before and after the intervention. It can be concluded from the findings that cooperative learning

activities had a positive impact on the academic achievement of students enrolled in the subject of Education. Also, in a study conducted by Dendup and Onthanee (2020), the cooperative learning teaching style was effective in enhancing English communicative abilities (ECA) of 19 grade four students at a school located in a remote and sparsely populated area in Bhutan.

Cooperative Learning linked with Academic Performance in Mathematics.

In the study conducted by Hagan et al. (2020) on Senior High School students in the Kumasi metropolis in the Ashanti region of Ghana, it was revealed that the students have a positive perception towards mathematics even though they find it challenging because of its importance in daily life.
Also, the beliefs about mathematics, from the perspective of students, are a factor in the academic performance of that area (Rincon et al., 2021)

The study conducted by Gamit et al. (2017) entitled "The Effects of Cooperative Learning in Enhancing the Performance Level of Grade-10 Mathematics Students in Talavera National High School in the Philippines" revealed that cooperative learning increased the Performance in Mathematics of the respondents. In addition, the effectiveness assessment revealed a highly effective result, and the method's implementation had a favorable impact on the participants, as seen by their positive attitudes toward mathematics. This is in line with the results of the study of Abdullah (2021), "The Effectiveness of Cooperative Learning in the Class of Inferential Statistics," which demonstrated that students like to learn in groups and that student performance improved after cooperative learning was implemented. It was concluded that cooperative learning effectively enhances student engagement and Performance.

Hossain and Tarmizi (2013) found that cooperative learning substantially impacted mathematics achievement and attitudes toward mathematics in Bangladesh. Exposure to cooperative learning affected students' mathematical Performance and attitudes toward mathematics. The findings revealed a significant improvement in math achievement and attitudes toward mathematics. As a result, cooperative learning can improve student performance in mathematics in Bangladeshi secondary schools.

Chan and Idris (2017) conducted a study titled "Cooperative Learning in Mathematics Education", intending to examine cooperative learning methods in the Student Teams Achievement Division (STAD) model to help students improve in mathematics. ACCORDING TO THE FINDINGS, the STAD model of cooperative learning improves students' cooperation with the teacher. It also increases students' Performance and problem-solving abilities constantly. It also aligns with the study made by Li, Yang and Payne (2015), where the findings revealed that students' critical thinking skills, retention rate, and the number of students receiving A's and C's all increased. Also, it was discovered that cooperative learning encouraged students to think critically and stay in class until the end.

4. Null Hypothesis

The researcher formulated the null hypotheses tested to solve the study.

1. There is no significant relationship between the respondents' academic performance in Mathematics and Performance during the pre-test.
2. There is no significant relationship between the respondents' academic performance in Mathematics and Performance after using cooperative learning.
3. There is no significant difference in the respondents' academic performance in pre-test and post-test.

5. Methodology

The research design used in the study is quasi-experimental. This design is frequently used to assess the efficacy of a treatment, such as an educational intervention. The study respondents were 101 grade 9 students and 84 grade 10 students both belonging to a heterogeneous group of classes in Bamban National High School at Bamban, Masinloc, Zambales, Philippines. Population sampling, a strategy for determining similar features or particular characteristics among participants, was utilized in this study.

The study used different instruments described: A test for grade 9 and grade 10 students created from the topics found in the DepEd Curriculum Guide for Mathematics 2013. The test for grade 9 students was adapted from Right Triangle Test Review and Introduction to trigonometry test, while the test for grade 10 students was adapted from the DepEd Learners' module for Grade 10. Each consisted of 30 items administered to determine the students' level of Performance in Mathematics. The type of test used was multiple choices, with one point given for each correct answer. While the intervention done through cooperative learning contains activities adapted from the DepEd Mathematics 9 and 10 Learners' Module. Before disseminating the instrument, the researcher asked

permission and approval from the school head of Bamban National High School. The researcher allotted a day for the pre-test, three weeks to utilise the strategy and one day for the post-test. The researcher personally facilitated the test to clearly explain and assist the students in answering the instrument. After the retrieval of the results of the tests given, the data was tallied, regrouped according to variables, tabulated and analysed according to the study's objectives.

The data gathered was tabulated for statistical treatment, analysis and interpretation. Frequency and Percentage Distribution, Weighted Mean, Pearson r Correlation Analysis, and T-test were among the statistical tools utilized in the data analysis and interpretation and hypothesis testing.

Decision-making can be determined using a model as a standard reference or by checking if behavioral manifestations and decisions can be accepted and cultivated.

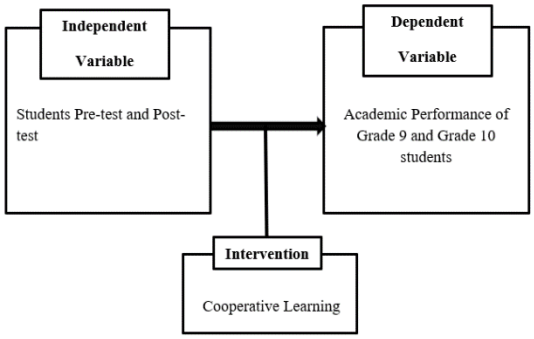

Figure 1. The Paradigm of the Study

The paradigm of the study, which used the independent variable-dependent variable approach (IV-DV), is shown in Figure 1. As specified in the first frame, the independent variable consists of the results of the respondents' pre-test and post-test.

The dependent variable as specified in the second frame indicates the students' academic Performance in mathematics.

As specified in the third frame,, the intervening variable is cooperative learning. All the respondents are involved in cooperative learning before taking the post-test.

6. Results and Discussion

Academic Performance of the respondents in Mathematics

Table 1 shows the academic Performance of the respondents in Mathematics. For Grade 9, out of 101 respondents, the majority of 57 or 56.44%, has a grade between 75 –79 with a descriptive equivalent of fairly satisfactory. The mean for academic Performance of the respondents in Mathematics of Grade 9 is 80.28 with a descriptive equivalent of Satisfactory.

For Grade 10, out of 84 respondents, the majority of 31 or 36.90% has a grade between 75 – 79 with a descriptive equivalent of fairly satisfactory. The mean for academic Performance of the respondents in Mathematics of Grade 10 is 82.98 with a descriptive equivalent of Satisfactory.

Table 1. Academic Performance of the Respondents in Mathematics

Descriptive Equivalent	Numerical Equivalent	Grade 9		Grade 10	
		Frequency	Percent	Frequency	Percent
Outstanding	90 & Above	12	11.88	14	16.67
Very Satisfactory	85 - 89	9	8.91	18	21.43
Satisfactory	80 - 84	19	18.81	21	25
Fairly Satisfactory	75 - 79	57	56.44	31	36.9
Did Not Meet Expectation	74 & below	4	3.96	0	0
	Total	**101**	**100**	**84**	**100**
	Mean	**80.28 Satisfactory**		**82.98 Satisfactory**	

**Based on DepEd Grading System*

The result shows that the average academic Performance of the grade 9 and 10 student respondents prior to the application of cooperative learning is satisfactory in the range of 80-84. Academic achievement is one tool in measuring the academic Performance of the students. The problems associated with mathematics achievement are still evident in the Philippine setting and other countries.

Level of Performance in Mathematics during Pre-Test

Table 2 shows the level of Performance of the respondents in Mathematics during the pre-test.

For Grade 9, the mean for the level of Performance of the respondents in Mathematics during the pre-test is 67.79, with a descriptive rating or did not meet the expectation.

For Grade 10, the mean level of Performance of the respondents during pre-test is 68.37, with a descriptive rating of did not meet expectations.

Table 2. Level of Performance of the Respondents in Mathematics during Pre – Test

Descriptive Equivalent	Numerical Equivalent	Grade 9		Grade 10	
		Frequency	Percent	Frequency	Percent
Outstanding	90 & Above	0	0	0	0
Very Satisfactory	85 - 89	0	0	2	2.38
Satisfactory	80 - 84	0	0	1	1.19
Fairly Satisfactory	75 - 79	8	7.92	6	7.14
Did Not Meet Expectation	74 & below	93	92.08	75	89.29
	Total	**101**	**100**	**84**	**100**
	Mean	**67.79 Did Not Meet Expectation**		**68.37 Did Not Meet Expectation**	

**Based on DepEd Transmutation Table*

The pre-test is typically used to determine if students have the prerequisite skills needed for the upcoming unit of instruction, or to what extent students have already achieved the objectives of planned instruction (Linn & Miller, 2005). Through this, teachers will be able to identify an intervention program that will address the student's problems in learning the subject.

Level of Performance in Mathematics during Post-Test

Table 3 shows the level of performance of the respondents in Mathematics during post-test.

The mean level of Performance of the respondents in Mathematics of Grade 9 during post-test is 80.52 with a descriptive rating of satisfactory. Meanwhile, the mean for the level of Performance of the respondents in Mathematics of Grade 10 during post-test is 81.35 with a descriptive rating of satisfactory**.**

Table 3. Level of Performance of the Respondents in Mathematics during Post–Test

Descriptive Equivalent	Numerical Equivalent	Grade 9		Grade 10	
		Frequency	Percent	Frequency	Percent
Outstanding	90 & Above	11	10.89	10	11.9
Very Satisfactory	85 - 89	13	12.87	15	17.86
Satisfactory	80 - 84	29	28.71	28	33.33
Fairly Satisfactory	75 - 79	39	38.61	23	27.38
Did Not Meet Expectation	74 & below	9	8.91	8	9.52
	Total	**101**	**100**	**84**	**100**
	Mean	**80.52 Satisfactory**		**81.35 Satisfactory**	

**Based on DepEd Transmutation Table*

The findings show that the level of Performance of the students after using cooperative learning as an intervention is satisfactory. This is in line with the study conducted by Hwang et. al (2008) that revealed that cooperative learning is more effective than traditional lecture for students raised and taught in a passive learning environment.

Significant Relationship between Academic Performance and Pre–Test

Table 4 shows the significant relationship between academic performance in Mathematics and pre–test performance of the respondents.

For grade 9, the computed Pearson r=0.213 denotes a slight relationship between academic Performance and pre–test performance of the respondents. Furthermore, the computed Pearson r=0.361 for grade 10 means a moderate relationship between academic Performance in Mathematics and pre–test of the respondents.

Table 4. Test of Significant Relationship between Academic Performance in Mathematics and Pre–Test of the Respondents

Source of Correlation	Grade 9	Decision/ Interpretation	Grade 10	Decision/ Interpretation
Pearson Correlation	0.213**	Slight Ho Moderate	0.361**	Reject Ho Moderate
Sig. (2-tailed)	0.03	Relationship	0	Relationship
N	101		84	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The computed significance value for grade 9 (Sig=0.03) and grade 10 (Sig=0.00) is less than the alpha significance value of 0.05; the results indicate that there is relationship respectively between academic Performance in Mathematics and pre – test performance of the respondents. Therefore, the null hypothesis is rejected.

Significant Relationship between Academic Performance and Post – Test

Table 5 shows the significant relationship between academic Performance in Mathematics and post –test performance of the respondents.

For grade 9; the computed Pearson r=0.732 denotes a high relationship between academic Performance and post –test performance of the

respondents. Furthermore, the computed Pearson r=0.583 for grade 10 means a moderate relationship between academic performance in Mathematics and post – test of the respondents.

The computed significance value for grade 9 (Sig=0.00) and grade 10 (Sig=0.00) is less than the alpha significance value of 0.05; the results indicate that there is relationship respectively between academic Performance in Mathematics and post – test performance of the respondents. Therefore, the null hypothesis is rejected.

The relationship between the academic Performance of the students and the result of the post-test given indicates the positive effect of cooperative learning when used as an instructional strategy in Mathematics. The study conducted by Zakaria, et. al. (2013) revealed that incorporating cooperative learning in the classroom would enhance the learning of mathematics in secondary schools.

Table 5. Test of Significant Relationship between Academic Performance in Mathematics and Post–Test of the Respondents

Source of Correlation	Grade 9	Decision/ Interpretation	Grade 10	Decision/ Interpretation
Pearson Correlation	0.732**	Reject Ho High	0.583**	Reject Ho Moderate
Sig. (2-tailed)	0.00	Relationship	0.00	Relationship
N	101		84	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Similarly, in a study conducted by Hossain and Tarmizi (2013), cooperative learning significantly affected achievement and attitudes towards Mathematics in selected secondary schools in Bangladesh. It was found that student's Performance in mathematics was affected by exposure to the cooperative learning.

Significant Difference on Level of Performance in Mathematics during Pre – Test and Post – Test

Table 6 shows the test of significant difference on level of Performance in Mathematics during pre-test and post-test of the respondents.

For grade 9; the computed significance value for grade 9 (Sig=0.00) and grade 10 (Sig=0.00) is less than the alpha significance value of 0.05; the results indicate a difference in the level of Performance in Mathematics during pre-test and post-test of the respondents. Therefore, the null hypothesis is rejected.

The study conducted by Tsay and Brady (2010) found that students who employed cooperative learning (group work) had good academic achievement.

Table 6. Test of Significant Difference on Level of Performance in Mathematics during Pre – Test and Post – Test of the Respondents

	Paired Differences					
	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Grade 9	-1.62376	1.22353	0.12175	-13.337	100	.000
Grade 10	-1.53571	0.93714	0.10225	-15.019	83	.000

Summary

Grade Level	df	Sig. (2-tailed)	Decision/ Interpretation
Grade 9	100	0.00	Reject Ho Significant
Grade 10	83	0.00	Reject Ho Significant

Also, the results indicated in the study of Alshammari (2015) indicated pupils in the experimental group regularly outperformed students in the control group on post-tests. The findings back up the study's hypothesis that Cooperative learning has a good overall influence on students' academic achievement.

5. Conclusion and Future Scope

The findings revealed that the respondents' academic Performance in Mathematics is satisfactory. The respondents' level of Performance during pre – test did not meet expectation for both grade 9 and grade 10. After using cooperative learning, the respondents' level of performance was satisfactory for grade 9 and grade 10. There is a significant relationship between the respondents' academic performance in Mathematics and pre – test level of Performance. There is a significant relationship between the respondents' academic performance in Mathematics and post-test level of Performance. There is a significant difference on the level of Performance of the respondents during pre – test and after using cooperative learning in Mathematics, both for grade 9 and grade 10.

Since there is a significant difference in students' pre-test and post-test Performance, it is safe to conclude that students' Performance in Mathematics improved following the intervention, cooperative learning. The

researchers recommends that teachers should have to discover new strategies to motivate and enhance the academic Performance of the students in Mathematics, like collaborative working arrangements that includes the context of sharing ideas and integrate it to the different instructional techniques suggested by different authors to enhance the learning of students in mathematics. Also, students can build a learning community that values diversity and develop good learning skills and social skills by exposing them to a learning setting that requires an active interaction between them, such as cooperative learning. It is suggested that further studies be made to widen the study's scope and validate the result obtained.

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