EFFECTIVENESS OF COOPERATIVE LEARNING ON THE ACADEMIC PERFORMANCE IN MATHEMATICS OF JUNIOR HIGH SCHOOL STUDENTS IN PHILIPPINES

Author's Name: [1]Gladys T. Dimatacot, [2]Katherine B. Parangat EdD

Affiliation: [1]Teacher III, Zambales National High School, Philippines

[2]President Ramon Magsaysay State University, Phillipines

E-Mail: gladys.dimatacot@deped.gov.ph

Abstract

One of the potential strategies for Mathematics instruction is cooperative learning. The study aimed to determine the effectiveness of cooperative learning on the academic performance in Mathematics of junior high school students. The respondents of the study were from Bamban National High School, Masinloc, Zambales, Philippines. 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 pre-test did not meet expectation for both grade 9 and grade 10 while the respondents' level of performance after using cooperative learning are both satisfactory for grade 9 and grade 10. The computed significance value for grade 9 and grade 10 indicates that there was a significant relationship between academic performance of the respondents in Mathematics and pre-test level of performance. Also, there was a significant relationship between academic performance of the respondents in Mathematics and post-test level of performance. Both grade 9 and grade 10 students was found having a significant difference on the level of performance on pre-test and on post-test after using cooperative learning as intervention.

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

INTRODUCTION

Mathematics is continually been regarded as a difficult and much less exciting subject by students. Through the years, teachers confronted issues in motivating and engaging the students in mathematics class. However, mathematics is considered as 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 guidelines on teaching and studying mathematics and its formative effects (Mihaela & Monica, 2014).

Parental practices on children's mathematical achievement are much stronger in most Asian countries (Wei & Dzeng, 2014). In 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 a range of educational areas use cooperative learning exercises as part of their teaching strategies (Tisha L.N., et al.,2016). Cooperative learning, as compared to other traditional teaching methods, 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 or not, students have always learnt by actively interacting with their surroundings. Learners who study mathematics under the guidance of experienced teachers will not only be able to perform basic calculations, but will also 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.

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 respondents of the study were 101 grade 9 students and 84 grade 10 students both belong to heterogeneous group of classes in Bamban National High School at Bamban, Masinloc, Zambales, Philippines. Population sampling, which is a strategy for determining similar features or particular characteristics among participants, was utilized in this study.

The study used different instruments described as follows: A test for grade 9 and for grade 10 students created from the topics that can be 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 consist of 30 items which was administered in order 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 the dissemination of 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 for the utilization of the strategy and one day for 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, re – group according to variables, tabulate and analyze according to the objectives of the study.

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, as well as hypothesis testing.

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, majority or 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, majority or 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	25.00
Fairly Satisfactory	75 - 79	57	56.44	31	36.90
Did Not Meet Expectation	74 & below	4	3.96	0	0.00
	Total	101	100.00	84	100.00
	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 grade 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 to mathematics achievement are still evident not only in the Philippine setting but also in other countries.

Level of Performance in Mathematics during Pre-Test

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

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

For Grade 10, the mean for level of performance of the respondents in during pre-test is 68.37 with a descriptive rating of did not meet expectation.

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	0.00	0	0.00
Very Satisfactory	85 - 89	0	0.00	2	2.38
Satisfactory	80 - 84	0	0.00	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	100.00	84	100.00

	Mean	67.79 Did Not Meet Expectation	68.37 Did Not Meet Expectation

*Based on DepEd Transmutation Table

Pre-test are typically used to determine if students have the prerequisite skills needed for the upcoming unit of instruction, or to what extent students 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 problems that the student is having 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.

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	11.90
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	100.00	84	100.00
	Mean	80.52 Satisfactory		81.35 Satisfactory	

*Based on DepEd Transmutation Table

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

The findings shows that the level of performance of the students after using cooperative learning as 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 who were raised and taught in a passive learning environment.

Significant Relationship between Academic Performance and Pre - Test
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 Relationship	0.361**	Reject Ho Moderate Relationship
Sig. (2-tailed)	0.03		0.00	
N	101		84	
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

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

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

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, null hypothesis is rejected.

Significant Relationship between Academic Performance and Post – Test

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

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 Relationship	0.583**	Reject Ho Moderate Relationship
Sig. (2-tailed)	0.00		0.00	
N	101		84	
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).				

For grade 9; the computed Pearson r=0.732 denotes that there is a high relationship between academic performance and post –test performance of the respondents. Furthermore, the computed Pearson r=0.583 for grade 10 means that there is 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, 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 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. Similarly, in a study conducted by Hossain and Tarmizi (2013), cooperative learning had significant effects on achievement and attitudes towards Mathematics in selected secondary schools in Bangladesh. It was found that students' 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 that there is difference on level of performance in Mathematics during pre-test and post-test of the respondents. Therefore, null hypothesis is rejected.

Table 6
Test of Significant Difference on Level of Performance in
sMathematics 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	.12175	-13.337	100	.000	
Grade 10	-1.53571	.93714	.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

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

CONCLUSIONS AND RECOMMENDATIONS
Based on the findings obtained in the study, the researchers concluded 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. The respondents' level of performance after using cooperative learning both satisfactory for grade 9 and grade 10. There is a significant relationship between academic performance of the respondents in Mathematics and pre – test level of performance. There is a significant relationship between academic performance of the respondents 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

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 both good learning skills and social skill by exposing them to a learning setting that requires an active interaction between them, such cooperative learning. It is suggested that further studies be made in order to widen the scope of the study and validate the result obtained.

sREFERENCES

[1] Ahmad Tarmizi, Rohani & Bayat, Sahar. (2012). Collaborative problem-based learning in mathematics: A cognitive load perspective. *Procedia - Social and Behavioral Sciences. 32. 344–350. 10.1016/j.sbspro.2012.01.051.*

[2] Alshammari, N.M. (2015). *Effects of cooperative learning on academic performance of college students in saudi arabia.*

[3] Bahman Motaei, On the Effect of Cooperative Learning on General English Achievement of Kermanshah Islamic Azad University Students, *Procedia - Social and Behavioral Sciences, Volume 98, 2014, Pages 1249-1254, ISSN 1877-0428*

[4] Hojjat Mahmoudi, Mohsen Koushafar, Javad Amani Saribagloo, Ghasem Pashavi, "The Effect of Computer Games on Speed, Attention and Consistency of Learning Mathematics among Students" Procedia - *Social and Behavioral Sciences,Volume 176,* 2015 ,Pages 419-424

[5] Hossain, A., & Tarmizi, R. A. (2013). *Effects of Cooperative Learning on Students' Achievement and Attitudes in Secondary Mathematics.* Procedia-Social and Behavioral Sciences, 93, 473-477.

[6] Hwang, N. C. R., Lui, G., & Tong, Y. J. W., Marian. (2008). *Cooperative learning in a passive learning environment: A replication and extension. Issues in Accounting Education, 23(1), 67-75. doi: 10.2308/ iace.2008.23.1.67*

[7] Linn, R. & Miller, M. (2005). *Measurement and Assessment in Teaching (9th Ed.).* Upper Saddle River NJ: Merrill-Prentice Hall.

[8] Mihaela Voinea, Monica Purcaru, "Boosting Romanian Students' Interest in Learning Mathematics through the Constructivist Approach", *Procedia - Social and Behavioral Sciences, Volume 127,2014,* Pages 108-113, ISSN 1877-0428

[9] Sangcap, Peter giovanni. (2010). Mathematics-related Beliefs of Filipino College Students: Factors Affecting Mathematics and Problem-Solving Performance. *Procedia - Social and Behavioral Sciences. 8. 465-475. 10.1016/j.sbspro.2010.12.064.*

[10] SEI-DOST & MATHTED, (2011). *Mathematics framework for Philippine basic education.* Manila: SEI-DOST & MATHTED. ISBN 978-971-8600-48-1

[11] Tisha L.N. Emerson, Linda English, KimMarie McGoldrick, *Cooperative learning and personality types, International Review of Economics Education, Volume 21, 2016, Pages 21-29, ISSN 1477-3880.*

[12] Tsay, M and M. Brady. (2010). *A Case Study of Cooperative Learning and Communication Pedagogy: Does working in teams make a difference*? Journal of the Scholarship of Teaching and Learning, Vol. 10, No. 2, June 2010, pp. 78-89.

[13] Valdez, A., Lomoljo, A., Dumrang, S., & Didatar, M. (2015). Developing critical thinking through activity –based and Cooperative Learning Approach in teaching high school chemistry. *International Journal of Social Science and Humanity, 5(1), 139-141.*

[14] Wei, M. H., & Dzeng, H. (2014). A comparison study of math education and math performance between Asian countries and the United States. *Journal of Socialomics, 3(02), 2167-0358.*

[15] Zakaria, E., Solfitri, T., Daud, Y., & Abidin, Z. (2013). Effect of Cooperative Learning on Secondary School Students' Mathematics Achievement. Creative Education, 4, 98-100.