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Effects of Dyad Cooperative Learning Strategy on Students' Academic Performance and Attitude towards Mathematics

Epifanio Rule Aguanta Jr.[1] and Denis Abao Tan[2]

[1]Old Damulog National High School, Old Damulog, Damulog, Bukidnon,Department of Education,8721 Philippines

[2]Central Mindanao University, University Town., Musuan, Bukidnon, 8710 Philippines

Abstract

The study examined the effectiveness of dyad cooperative learning strategy (DCLS) in teaching Grade 9 Mathematics on students' academic performance and attitude towards Mathematics of Old Damulog National High School (ODNHS) for the School Year 2017-2018. Specifically, the study sought to: (1) ascertain the level of students' performance in Mathematics who are exposed to DCLS and those who are exposed to non-DCLS; (2) describe the attitude towards Mathematics of students who are exposed to DCLS and those exposed to non-DCLS; (3) compare the performance of students who are exposed to DCLS and those exposed to non-DCLS; (4) determine the significant difference between the attitude of students towards Mathematics who are exposed to DCLS and those exposed to non-DCLS.

The study found out that students exposed to DCLS have significantly higher performance as to those exposed to non-DCLS in terms of posttest and retention test scores. No significant difference was found in the attitude of students towards Mathematics in both groups, although the DCLS group had a higher attitude rating than the non-DCLS group.

Introduction

Mathematics as the queen of all sciences must be given much attention and importance. As a science of numbers, it aims to enhance and brighten the mind through better ways of solving problems. As this mathematical world becomes more complex, every person must have enough knowledge and understanding of Mathematics in order to survive. In fact, the National Council of Teachers of Mathematics (NCTM) stresses that those who understand and can do Mathematics will have opportunities that others do not. This is because mathematical competence opens doors to endless opportunities.

Most of the observations noted that majority of students find Mathematics boring, dry, dull, difficult, uninteresting and irrelevant. These are some answers in a question on how individual learns all the mathematical concepts and procedures for over the past several decades. Though Mathematics is fascinating, most students find the subject creepy and daunting (Ahmed & Sarma, 2013).

In an interview of an action research conducted by Dusaran (2014), majority of her

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student hate Mathematics and they do not like to deal with numbers, forms, variables, and mathematical symbols. They find it very hard to study Mathematics. In fact, the Mathematics teachers of Old Damulog National High School (ODNHS) are faced with the actuality of students having a negative attitude towards Mathematics and they certainly do not fully grasp the mathematical concepts and procedures introduced. This is evident in the Mathematics achievement of students where a very large fraction attains a fairly satisfactory performance for having the average grades of 75% to 79% and the result of National Achievement Test was very low in the field of Mathematics having the average percentage score for three years of 55.27% which is far from the standard mean percentage score of 75%. This shows that majority of the students do not attain the mastery level of understanding the subject (SIP, 2014-2015).

Due to the aforementioned contexts, the researcher seeks to find an intervention which may possibly remediate the problem of teachers and students in teaching and learning Mathematics today. Improving the quality of teaching by employing effective strategies and by promoting students' participation in class may change students' perception and understanding in the subject. It is the hope of the researcher that the strategy he seeks for will improve students' academic performance and change students' negative attitude to positive attitude towards Mathematics. This technique is dyad cooperative learning.

Dyad cooperative learning was based from the dyadic alternative, an idea from Licht, a cooperative learning approach where students with good class standing in Mathematics were paired with those who were not performing well in Mathematics in a series of classroom activities and quizzes. Pretest and posttest were done individually and in between those tests was the series of activities and quizzes with their buddies.

Research findings of Zimbardo, Butler, and Wolfe (undated) were reduced test anxiety, more confidence and increased enjoyment of the course and subject matter when students took examination with a partner. Students in pair perform much better than when solo, they learn more together and enjoy the course and exam even more. With this, dyad cooperative learning as a strategy has its advantage to gain positive results in both students' performance and attitude towards Mathematics.

Hence, it gives the researcher an idea to conduct a study on the effects of dyad cooperative learning strategy (DCLS) on students' academic performance and attitude towards Mathematics.

Review of Literature

Students' Mathematics Academic Performance

Mathematics is a science of critical and analytical thinking. Much more than its important concepts and solutions are the values that it can instill in the young minds of the students. The learners are trained not only to solve mathematical problems but they are also taught with the essential disciplines necessary for them to survive in this wonderful yet complex world.

Research findings of Mbuguan, Kibet, Muthaa, and Nkonke, (2012) that understaffing, inadequate teaching and learning materials, lack of motivation and poor attitudes of both teachers and students are factors in poor Mathematics performance among students. Additionally, Tuminaro and Redish (2014) mentioned the two possible distinct reasons for this poor

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performance which include the students' lack of the mathematical skills needed to solve problems in physics and lack of knowledge on how to apply the mathematical skills they have to particular problem situation in physics. Thus, teachers should be skillful enough to adopt a critically reflective stance towards their practice and be aware of how students are experiencing their learning for them to do good work (Brookfield, 2006). Teachers should consider the fact given by the Educational Academy of Education saying that people learn by employing effective and flexible strategies that help them to understand, reason, memorize and solve problems and learn best when they participate in activities that are perceived to be useful in real life and are culturally relevant.

Williams and Pritchard (2006) said that people do have different abilities, but one can aspire to his or her personal best performance. They also believed that all children should have the opportunity to strive for their own personal excellence so as to take up their responsibilities as citizens. Madden, Slavin, and Simons (1999) also stated that every child has the capacity to succeed in a rich and demanding curriculum with appropriate assistance and support. Furthermore, Freeman, Eddy, McDonough, and Smith (2014) found out that students in classes with traditional lecturing were 1.5 times more likely to fail than students in classes with active learning.

Attitude Towards Mathematics

Attitude towards Mathematics is the degree of effect associated with Mathematics or the emotional disposition toward the subject which may either positive or negative. The emotional disposition has an impact in an individual's behavior. The positive emotional disposition results to the positive attitude or behavior towards Mathematics and is, therefore, favorable and desirable since it influences one's willingness to learn from Mathematics instruction (Hannula, 2002). Moreover, Eshun (2007) emphasized that this disposition has been acquired by an individual through his or her beliefs and experiences and this can be changed. Fraser and Kahle (2007) marked that the significant amount of change in students' attitudes towards the subject are due to the learning environments at home, in school and within the peer group.

Subsequently, Nicolaidou and Philippou (2003) stated that the attitudes towards Mathematics become more negative because of the number of factors including the pressure to perform well, over demanding tasks, uninteresting lessons and less than positive attitudes of the teachers. A child stops from learning when the child is feeling uncomfortable, distracted or under pressure, feeling confuse by abstract concepts of grammar rules and their application which they cannot easily understand, activities which require them to focus attention for a long time, boredom and for being over corrected.

And since students' attitudes are essential to their learning as emphasized by Poligrates (2011), a Mathematics teacher should exert much effort to develop and maintain the positive attitudes of the students towards Mathematics.

Dyad Cooperative Learning

This is a cooperative learning approach based from dyadic alternative in which students work together in pairs, share and discuss with one another. It was suggested by Licht and is based on the idea that "two heads are better than one." The dyadic cooperative learning of the

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students takes more responsibility for their own learning and encourages cooperation and active learning during discussion. In addition to, the dyadic cooperative learning helps to create a more social, less competitive atmosphere that the students value and enjoy. Moreover, it exposes students to a more realistic teaching/learning model, one where collaboration is necessary and important. The dyadic alternative is just that, an alternative. What it offers to students, at the very least, is a change of pace. It is an appreciated break from the traditional lecture method of teaching/learning (Savage, 1998).

According to research, it shows that dyads have many advantages as a functional unit for collaborative learning. Through dyads, the participation by all students is increased. The larger the group, the more opportunity there is for diffusion of responsibility among group members or for exclusion of some members. Also, Active participation in the collaborative process is essential for learning to occur. (www.education.stateuniversity/Cooperative-Collaborative-Learning.com)

The studies of Henson, Hagos, and Villapando, (2009) found out reciprocal peer tutoring was able to generate ideas, foster interdependence and communication among students since the activity encouraged students to read in advance and be better prepared for classroom discussion, provided an effective way for the students to work collaboratively through continuous students' interaction in small groups and provided a technique that induced reinforcement and motivation to increase the interest of the students. The performance of students in college Algebra exposed to RPT was significantly higher than the control group without the intervention.

Moreover, the findings of Topping (2001) found out that both peer learning and cooperative learning improved students' academic achievement. He also confirmed that peer learning and cooperative learning could yield positive results when it is implemented with thoughtfulness and with reasonably high implementation integrity.

Sampsel (2013) found out an increased in students' participation during class discussion, increased comfort when sharing their thoughts and ideas with peers using Think-Pair-Share in her classes. Moreover, students are communicating their thinking more than passive students who only listen and receive instruction from teacher. She added, the technique has many benefits which include providing the opportunity for students to learn from each other, promote students' mathematical vocabulary, reasoning, and problem solving skills through practice with their partners, and help students increase their confidence in their Mathematics abilities and the ability to contribute in class discussion. Ifamuyiwa and Akinsola (2008) also affirmed that cooperative learning approach increased attitude towards Mathematics.

Lizano (2015) concluded that assessment technique through a quiz buddy improved Mathematics achievement. A cooperative learning with a quiz buddy increased student retention and limits anxiety as students are not overloaded with information and students actually get time to think about, to talk about, and process information.

Methodology

The quasi-experimental research design was used in this study. This type of design used two intact classes which were subjected to the same pretest, posttest, and retention test to determine the significant difference on the academic performance and their attitude towards Mathematics.

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The study was conducted at Old Damulog National High School, a public institution situated in Damulog, the southernmost part of the province of Bukidnon, Philippines. It offers the K to 12 Basic Education Curriculum which provide a solid foundation in Mathematics.

The participants of the study were the Grade 9 students of Old Damulog National High School who are officially enrolled in Grade 9 Mathematics course for the school year 2017-2018.Each sections consisted of 38 students as subjects of the study.

Prior to instruction, the pretest and the attitude test were administered to experimental and control groups to determine the initial level of the learning competencies and attitude of the students towards Mathematics. The study was conducted daily. After all the selected topics were covered, a posttest (same as the pretest) was given to determine students' performance, and the same attitude test was administered to determine the attitude of the students after the intervention. The retention test was then administered a week after the posttest was given.

A 50 item, teacher-made multiple choice test was constructed by the researcher. The questions were taken from the Grade 9 Mathematics Learner's Module prescribed by the DepEd K to 12 curriculum. The content and reliability of the test items were validated by experts. It was analyzed with the reliability (Kr21) equal to 0.731.

The Fennema-Sherman Mathematics Attitudes Scale was used to determine the attitude of students towards Mathematics with the Cronbach's Alpha of 0.946.

Descriptive statistics like mean, standard deviation, frequency and percentage were used to determine the levels of academic performance and the attitude towards Mathematics.

The Analysis of Covariance (ANCOVA) was used to compare the performance of students as well as the difference of students' attitude towards Mathematics between groups.

Findings

To ascertain the level of students' performance in Mathematics in control and experimental groups in the pretest, posttest and retention test, descriptive statistics such as mean, frequency, and percentage were used.

DCLS group obtained the mean score of 13.97 while the non-DCLS group got the mean score of 12.24 in the pretest. These results revealed that both students exposed to DCLS and those exposed to non-DCLS groups obtained the scores that are below average signifying their very low performance.

As to the posttest, the DCLS group obtained a mean score of 25.13 indicating a "low performance" result while the non-DCLS group had a mean score of 19.34 indicating a "very low performance" result.

Retention test results showed a very low performance for both DCLS and non-DCLS groups. The students exposed to DCLS got a mean score of 23.50 while those exposed to non-DCLS got a mean score of 19.74. This result suggests that both DCLS and non-DCLS groups failed to meet the standards set by the Department of Education.

To describe the attitude of students towards Mathematics in control and experimental groups before and after the experimentation, descriptive statistics such as mean, frequency, and percentage were also used.

Before the experimentation, the attitude rating of students towards Mathematics when exposed to DCLS was 3.59 and students exposed to non-DCLS was 3.41. This implies that students exposed to DCLS and those exposed to non-DCLS both revealed a positive attitude

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towards Mathematics. They are positive in recognizing the importance and usefulness of Mathematics in making them survive in their day-to-day existence and in building their bright future.

After the experimentation, DCLS group got an attitude rating towards Mathematics of 3.66 while the non-DCLS group obtained 3.53 in their attitude rating towards Mathematics. This shows that students in both groups after the intervention remained to have positive attitude towards Mathematics. Moreover, students in DCLS group have higher mean compared to those students in Non-DCLS group.

To compare the performance of students exposed to DCLS and those exposed to non-DCLS in terms of posttest and retention test, the analysis of covariance (ANCOVA) was used.

The F-value between groups in the posttest is 18.226 with a probability value of 0.000 (p<0.05) indicating a highly significant difference, thus the null hypothesis which states that the performance of the students exposed to DCLS is comparable to those students exposed to non-DCLS in terms of posttest is rejected. The probability value further implies that both students exposed to DCLS and those who are exposed to non-DCLS groups significantly differ on their performance in the same posttest. Undeniably, students who were exposed to DCLS performed better than those students who were exposed to non-DCLS because it is very obvious that those who make it alone can do little compare to those who do it in a group or pair in doing a certain task. Students exposed to DCLS have worked easily and conveniently because of the chances that they could ask an assistance from each other which have developed their sense of trust, attitude, and skills and also it motivates students to learn better by the help of others. This fact is supported by their posttest mean scores which are 25.13 and 19.34 for the DCLS group and those exposed to Non-DCLS group, respectively.

This result is supported with the previous studies of Henson, Hagos, and Villapando, (2009) who found reciprocal peer tutoring (RPT) was able to generate ideas, foster interdependence and communication among students since the activity encouraged students to read in advance and be better prepared for classroom discussion, provided an effective way for the students to work collaboratively through continuous students' interaction in small groups and provided a technique that induced reinforcement and motivation to increase the interest of the students. The performance of students in college Algebra exposed to RPT was significantly higher than the control group without the intervention. Moreover, Topping (2001) strengthened the findings of this study were he found out that both peer learning and cooperative learning improved students' academic achievement.He also confirmed that peer learning and cooperative learning could yield positive results when it is implemented with thoughtfulness and with reasonably high implementation integrity.

Table 1. Comparison of students' performance on the posttest

GROUP	N	Mean	Std. Deviation
DCLS	38	25.13	5.07
Non-DCLS	38	19.34	5.25
TOTAL	76	22.24	5.89

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.

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Group	460.960	1	460.960	18.226	0.000**	**
Covariate(Pretest)	122.643	1	122.643	4.849	0.031*	
Error	1846.252	73	25.291			$p< 0.01$
Total	40186.000	76				
Corrected Total	2605.737	75				*$p<0.05$

The F-value between groups in the retention test is equal to 4.893 with a probability value of 0.030 (p<0.05) indicating a significant difference, thus the null hypothesis which states that the performance of the students exposed to DCLS is comparable to those students exposed to non-DCLS in terms of retention test is rejected. The result implies that students exposed to DCLS and those exposed to non-DCLS significantly differ on their retentive ability. Students exposed to DCLS possess better retention ability and attained better performance in the retention test than students who are exposed to non-DCLS. This is because students who work with partners increased practice, responding and feedback for students. The more they have practice activity, the more they master skills and competencies which enhance their retentive ability. This finding is supported by the group's retention test mean scores where students exposed to DCLS obtained 23.50, a mean score which is significantly higher than those students exposed to non-DCLS who got a mean score of only 19.74. This means that dyad cooperative learning strategy is better and more effective in enhancing students' retentive ability and in improving students' mathematics performance than the non-dyad cooperative learning strategy.

The table also suggests that the level of students both exposed DCLS and those exposed to non-DCLS after being exposed to different interventions is very low and did not meet the expectations set by the Department of Education. However, the mean scores of 23.50 and 19.74 for DCLS and those exposed to non-DCLS groups, respectively, suggests that those who were exposed to DCLS in learning the subject has better ability in getting hold of valuable information and in recalling the important concepts previously learned than those who were exposed to non-DCLS.

The result conforms with the study of Lizano (2015) entitled "Students' Mathematics Performance with Quiz Buddy in a Cooperative Learning Environment" that assessment technique through a quiz buddy improved Mathematics achievement. She also found out that CLQB increased student retention and limits anxiety as students are not overloaded with information and students actually get time to think about, to talk about, and process information. The result is also in line with the findings of Sampsel (2013) where an increased in students' participation during class discussion, increased comfort when sharing their thoughts and ideas with peers are some benefits gained using Think-Pair-Share.

Table 2. Comparison of students' performance on the retention test

GROUP	N	Mean	Std. Deviation
DCLS	38	23.50	6.18
Non-DCLS	38	19.74	5.68
TOTAL	76	21.62	6.19

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.

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Group	166.379	1	166.379	4.893	0.030**	**
Covariate(Pretest)	126.482	1	126.482	3.719	0.058	
Error	2482.386	73	34.005			*p<0.05*
Total	38397.000	76				
Corrected Total	2877.934	75				

To determine the significant difference of the attitude of students towards Mathematics between groups in terms of posttest, analysis of covariance (ANCOVA) was used.

As shown in table 3, the students' attitude in the DCLS and non-DCLS groups have the mean score of 3.66 with standard deviation of 0.31 and the mean score of 3.53 with standard deviation of 0.38, respectively. Moreover, the table shows an F-value of 0.252 and a probability of 0.617 ($p>0.05$) indicated with no significant difference in the attitudes of two groups, thus the null hypothesis stating that the attitude towards Mathematics of the ODNHS Grade 9 students exposed to DCLS is comparable to those who are exposed to non-DCLS failed to be rejected. Students' attitude towards Mathematics in both groups are statistically equal, it is because feelings and emotions need enough time in order to change. A mind may change easily but it's hard to change the feeling or emotion easily. Thus, students exposed to DCLS should have longer time of implementation in order to see its significant effects in the attitude of students towards Mathematics.

Granting the mean scores of the two groups are likely similar, it can be detected that the DCLS group has a higher mean score as compared to the non-DCLS group which means that more students who were exposed to DCLS responded positively on the attitude survey questionnaire than those students who were exposed to non-DCLS.

The result is supported by the study of Silabay (2002) where the researcher found out that there was an increase in the attitude test rating within and between the two groups before and after intervention; but the t-test results of the two Mathematics attitude tests within and between two groups indicated a non-significant difference and maintained a positive attitude towards Mathematics. Moreover, Ifamuyiwa and Akinsola (2008) affirmed that cooperative learning approach increased attitude towards Mathematics.

Table 3. Comparison of students' attitude between groups

GROUP	N	Mean	Std. Deviation
DCLS	38	3.66	0.31
Non-DCLS	38	3.53	0.38
TOTAL	76	3.60	0.35

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Group	0.011	1	0.011	0.252	0.617^{ns}	*Note: ns-not significant at 0.05 levels*
Covariate(Pretest)	4.893	1	4.893	115.598	0.000**	
Error	3.090	73	0.042			**$p<$ 0.01
Total	991.903	76				
Corrected Total	8.310	75				

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Conclusion

Based on the findings of the study, the following conclusions are drawn:

Students' performance in the pretest is very low for both DCLS and those exposed to non-DCLS groups which indicates that they did not meet the expectations set by the Department of Education. After the intervention, students in the DCLS group achieve a low performance in the posttest and a very low performance in the retention test while students in the non-DCLS group achieved a very low performance for both posttest and retention test indicating that the group did not meet the expectations set by the Department of Education.

Both students exposed to DCLS and those exposed to non-DCLS have positive attitude towards Mathematics before intervention. After the intervention, students exposed to DCLS and those who are exposed to non-DCLS remained to have positive attitude towards Mathematics.

There is a significant difference in the performance of students in Mathematics when exposed to DCLS and those exposed to non-DCLS. Students in the DCLS group have a better performance both in the posttest and retention test than those students in the non-DCLS group.

The attitude of students towards Mathematics when exposed to DCLS is comparable to those exposed to non-DCLS. Thus, there is no significant difference in the attitude of students towards Mathematics when exposed to DCLS and those exposed to non-DCLS.

Suggestions and Recommendations

Based on the summary, findings and conclusions of the study, the following recommendations are given.

Mathematics teachers are encouraged to use dyad cooperative learning strategy (DCLS) in their instruction because this was found to be a better teaching method in improving students' academic performance.

Teachers may further conduct a Mathematics attitude survey among its students at the start of the school year for them to better identify and assess the level of attitude among its students wherein if it will become negative, an appropriate teaching strategies will be employed to resolve the case immediately. Using dyad cooperative learning in the classroom can improve students' attitude, hence using the said intervention is encouraged. Duration of the intervention might be a great factor to improve students' attitude, thus longer duration of the intervention is highly suggested.

Teachers, administrators, and curriculum makers may consider to provide pedagogies and updated method to improve confidence of the students and their attitude towards Mathematics. Therefore, trainings to improve the said aspect might be necessary to provide students better learning experiences with successful outcomes.

Lastly, further research is suggested to include other variables which are not included in the study. The longer duration of implementation is highly suggested for effectivity and reliability of the methods used.

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