

Cooperative Learning as a Strategy in Solving Word Problems in Mathematics

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DOI: 10.29322/IJSRP.11.10.2021.p11848
<http://dx.doi.org/10.29322/IJSRP.11.10.2021.p11848>

Abstract- This study analyzes the attitude of the students in Agusan National High School (ANHS) towards cooperative learning as a strategy in solving word problems in mathematics. In answering the objectives this study used a twenty-one-item survey questionnaire based on the five components of cooperative learning and another five items for the word problem. The study has a null hypothesis stating that there is no significant relationship between cooperative learning and mathematics performance of the students and there is no significant difference in the mathematics performance of the students before and after the cooperative learning is applied. It is concluded that the grade 10 students got a very high level of attitude in positive interdependence and social skills, while promotive face-to-face interaction, individual accountability, and group processing only got a high level of attitude.

Index Terms- Cooperative Learning, Mathematics Performance, Word problems

I. INTRODUCTION

Research on cooperative learning was scarce before the 1970s, however, since this date, the amount and the quality of research on cooperative learning have greatly accelerated given its great appraisal and positive effects on education (Slavin, 1996). Numerous studies have stressed the positive effects that cooperative learning has on academic achievement (Jensen & Moore, 2002; Gillies & Ashman, 1996; Rojas-Drummond, Hernandez, Velez, & Villagran, 1998; FergusonPatrick, 2007) and social interaction (Jordan & Le Métais, 1997; Vasileiadou, 2009; Choi, Johnson, & Johnson, 2011) among other outcomes. Cooperative learning has become such a widely used instructional procedure in all educational contexts that it is even difficult to find instructional material that does not refer to this methodology (Johnson, Johnson & Stanne, 2000).

As of 2009 more than 1,200 research studies had been conducted on cooperative learning, and a significant amount of those studies focused on the effects of cooperative learning on achievement in comparison to more traditional, individualistic, or competitive instructional methods (Johnson & Johnson, 2009). High school students perform better through cooperative learning than from a teacher-centered approach (Gillies, 2016). Cooperative learning also enables students to effectively accomplish practical procedures, perform valid research hence making it easier for the educators to manage student's learning. In addition, CL encourages the students to effectively contribute

towards the problems solving leading to a better understanding of the subjects (Davidson & Major, 2014). Cooperative learning could be presumed to be a better approach that could benefit students in the Philippines, only if it could be implemented properly.

This study was conducted to determine if cooperative learning is one of the best strategies if not, a highly recommended one in solving word problems in mathematics.

This study hopefully contributed to the improvement of education in mathematics. This research encouraged the faculty administration and also the teachers to be drawn to this method of teaching a student-centered approach and to adapt it as an effective teaching strategy that will benefit the students. The outcomes to be considered are the improvement of students' abilities in terms of positive interdependence, promotive face-to-face interaction, individual accountability, social skills, and group processing. The participants of the study were Grade 10 students of Agusan National High School (ANHS). Among the 1021 students, 105 students served as the participants of the study. The researchers used a survey questionnaire for the survey as observation and gathering of data among the participants.

II. THEORETICAL AND CONCEPTUAL FRAMEWORK

This study does not just follow from one single theoretical perspective, but it mainly covered the theories of Deutsch, Lewin, Piaget, Vygotsky, Dewey, Springer, Millis, and Johnson.

Scholars within the cooperative learning literature often refer to such disparate fields as philosophy of education, social psychology, cognitive psychology, and behaviorism and educational theorists such as Morton Deutsch, Kurt Lewin, Jean Piaget, Lev Vygotsky, and John Dewey (Roseth et al., 2008; Springer et al., 1999; Millis, 2010; Johnson & Johnson, 1989). While the grounding in so many fields of psychology is seen as the strength of cooperative learning (Johnson & Johnson, 1989), it naturally causes some confusion as to whether one can speak of a cooperative learning theory as such. Springer et al. (1999) distinguished between motivational, affective, and cognitive perspectives on cooperative learning. Dansereau and Johnson (1994) distinguished between social-behavioral perspectives and cognitive developmental perspectives. Slavin (1994) also distinguished between motivational and cognitive perspectives on cooperative learning but later distinguished between motivational, social cohesion, cognitive, and developmental perspectives (Slavin, 1996) as shown in Table 1.

Table 1. Theoretical perspectives on cooperative learning

Theoretical perspective	Assumptions
Motivational (behavioral) perspectives	If students are rewarded for cooperation or if their achievement is in part contingent upon the achievement of fellow group members, they will help each other to maximize their outcome.
Social cohesion perspectives	If students value peers and are dependent on each other they will be likely to help one another to reach their goals.
Developmental perspectives	Interaction with peers is likely to result in cognitive disequilibrium. Inadequate reasoning will be exposed, and higher-quality understandings will emerge.
Cognitive elaboration perspectives	Retention of knowledge in memory needs cognitive restructuring. Explaining material to someone else is an effective means of elaborating.

Conceptual Framework

Cooperative learning structures seek to provide higher student engagement in the classroom. Cooperative learning is not just placing students together in small groups. Small-group instruction in the loosest sense is physically arranging students in groups as instruction proceeds. However, a stricter sense of small group instruction refers to using specific instructional strategies while students are placed into small groups for learning (Abrami, Lou, Chambers, Poulsen, & Spence, 2000). Cooperative learning would lean toward a stricter sense. Cooperative learning is more than just group work. It is structured to maximize learning and communication within the group (Kagan & Kagan, 2009). A cooperative learning group is also seen as a group that works together to accomplish a common learning goal and regularly checks for progress and performance toward a learning goal. The

outcome is that everyone in the group gained academic performance (Johnson & Johnson, 1999).

These were five elements that distinguish cooperative learning. Positive interdependence refers to the sense of the group succeeding or failing together. Face-to-face promotive interaction requires students to help each other learn as well as to applaud the success and effort of their team members. The individual and group accountability measures indicate the importance of each group member making contributions to the team. Interpersonal and small group skills require communication, trust, and team building. Finally, group processing is referred to as groups reflecting on their progress toward a common goal (Marzano, Pickering & Pollock, 2001).

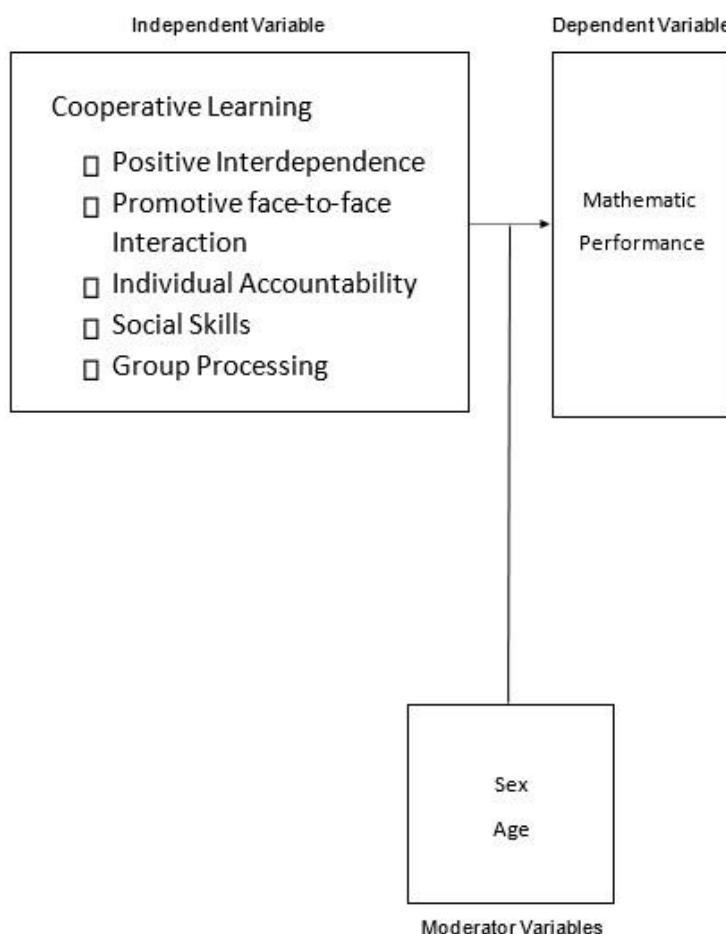


Figure 1. Flow chart of the study

III. RESEARCH METHODOLOGY

This study employed the descriptive survey method of research. It was descriptive because it provided pieces of information on the students' demographic profiles. Moreover, it also determined whether relationships and differences exist between the set of variables in the study. The questionnaire served as the main data-gathering instrument to sought answers to the problems in the study.

This study was conducted in Agusan National High School (ANHS), Division of Butuan City. It is one of the largest

secondary public schools in Caraga Region. It is located at A.D. Curato Street, Butuan City, near the National Highway. The school can be reached by riding multicab or a motorcycle. It is 2 kilometers away from the city proper and it will just take 5 minutes to travel.

The population of the study was the Grade 10 students of Agusan National High School that were enrolled during the academic year 2017-2018. There were 1021 students and 105 of them served as participants of the study.

Table 1. The Distribution of population as respondents of the study

Population		Total
Female	Male	
69	36	105

To get the number of participants in the study, the researchers chose the Grade 10 students. The selection was done through stratified random sampling and only 10% of the students served as the participants.

The study used a survey questionnaire as its research instrument. This was self-constructed and was composed of three (3) parts. Part 1 showed the demographic profile of the students, part 2 showed the students' attitude towards cooperative learning that included the positive interdependence, promotive face-to-face

interaction, individual accountability, social skills, group processing, and part 3 showed the sets of word problems, five (5) items, specifically. The researchers used an appropriate scaling for the given questions to ensure student's reliable responses.

The researchers self-constructed the survey and were validated by two (2) experts and undergone pilot testing at Carmen National High School and Nasipit National Vocational School that covered 60 participants.

The distribution of survey questionnaires relied upon the validation of experts. After which, it underwent pilot testing at Carmen National High School and Nasipit National Vocational School to make sure that it was reliable for distribution. The researchers primarily wrote a letter of permission for the

distribution of survey questionnaires. After the letter is approved, the researchers then asked the mathematics teacher's consent to survey her class.

The researchers surveyed by distributing the questionnaires. The questionnaires were retrieved right after the participants have answered all items. The same questionnaire was conducted the next week with the same respondents. But this time, it was answered individually.

The data gathered were analyzed according to the study objectives. After gathering the data, the researchers utilized the frequency, weighted mean, and p-value for the analysis of data, interpretation purposes, and conclusions.

Scoring and Quantification of Data

The following variables were scored as follows:

Scale	Verbal Description	Interpretation
5	Always	Very High
4	Almost Always	High
3	Often	Average
2	Seldom	Below Average
1	Never	Low

The researchers used these statistical tools in the analysis and interpretation of data:

1. frequency for the description of the participants' demographic profile;
2. Weighted mean for the students' perception towards cooperative learning and students' scores in word problems, by individual and by group; and
3. p-value for the significant relationship between students' attitude towards cooperative learning and for the significant difference of the students' scores by group and individual.

IV. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

Problem 1. What is the personal profile of the students in terms of: age and gender?

Table 2. Distribution of the students' age

Age Category	Frequency	Percentage
15 and below	34	32.4
16 to 17	68	64.8
18 and above	3	2.9
Total	105	100.0

As shown in the above table, in terms of age, there were 105 total students in which 34 of the participants were 15 years old and below, that is 32.4%, 68 were 16 to 17 years old, that is 64.8%, and 3 out of 105 participants were 18 years old and above,

that is 2.9%. The data implied that most of the participants were 16 to 17 years old.

Table 3. Distribution of the students' gender

Gender	Frequency	Percent
Female	69	65.7
Male	36	34.3
Total	105	100.0

Table 3 shows the profile of the participants in terms of gender, out of 105 students, 69 of them were female, that is 65.7%, and 36 were male, that is 34.3%. This implied that the majority of the students were female.

Problem 2. What is the attitude of the students about cooperative learning in terms of positive interdependence, promotive face-to-face interaction, individual accountability, social skills, and group processing?

Scaling

Range	Verbal Description	Interpretation
1.000 – 1.800	Never	Low
1.801 – 2.600	Seldom	Below Average
2.601 – 3.400	Often	Average
3.401 – 4.200	Almost Always	High
4.201 – 5.000	Always	Very High

Table 4. Students' Attitude towards Cooperative Learning concerning Positive Interdependence

Particular	Mean Score	Remark	Interpretation
1. I consider my groupmates' ideas.	4.5619	Always	Very High
2. I participate in brainstorming done by the group.	4.2667	Always	Very High
3. I am responsible for every task I am assigned.	4.0476	Almost	High

OVER-ALL 4.2920 Always Very High

Table 4 shows that the participants got a very high level in terms of positive interdependence, having an over-all mean score of 4.2920. This implies that the students always perceive that

working together is individually and collectively beneficial, and success depends on the participation of all the members.

Table 5. Students' Attitude towards Cooperative Learning with respect to Promotive Face-to-Face Interaction

Particular	Mean Score	Remark	Interpretation
1. I am considerate of my groupmates' feelings.	4.3905	Always	Very High
2. I deliver my opinion well.		Almost Always	High
4.0000			
3. I interact with my groupmates to make them feel they are part of the group.	4.3143	Always	Very High
4. I disapprove of someone's opinion in a constructive way.	3.8365	Almost Always	High
5. I don't force my groupmates to contribute something in the group.	3.7524	Almost Always	High
OVER-ALL 4.0571		Almost Always	High

As shown in the above table, particulars 1 and 3 got a very high level in terms of promotive face-to-face interaction. Then, the remaining particulars got a high level of the mean score. This implies that the students sometimes facilitate learning and contributions by each other.

Table 6. Students' Attitude towards Cooperative Learning concerning Individual Accountability

Particular	Mean Score	Remark	Interpretation
1. I consider my groupmates' ideas but what matters most is my contribution to the group.	3.7429	Almost Always	High
2. My performance, even when I am in a group, is what will shape my grade.	3.9714	Almost Always	High
3. I am concern with how well I perform the task not on how well we perform the task.	3.4952	Almost Always	High
4. My assigned task is better organized when I work alone.	3.7905	Almost Always	High
OVER-ALL	3.7500	Almost Always	High

The table implies that the students got a high level in terms of individual accountability, having an overall mean score of 3.7500. The perception's remark is almost always; this means that

the students sometimes do not just rely on their classmates' contribution but also to theirs.

Table 7. Students' Attitude towards Cooperative Learning concerning Social Skills

Particular	Mean Score	Remark	Interpretation
1. I willingly share my idea with the group.	4.1810	Almost Always	High
2. I find no hard time working with groups.	4.2095	Always	Very High
3. Working in a group is way more comfortable than working alone.	4.1619	Almost Always	High
4. I don't put barriers between me and my groupmates.	4.1714	Almost Always	High
5. Working in a group is a whole lot of fun.	4.3905	Always	Very High
OVER-ALL	4.2229	Always	Very High

As shown in the above table, particulars 2 and 5 got a very high level in terms of social skills, having the mean score of 4.2095 and 4.3905, respectively. Then, the remaining particulars

got a high level of the mean score. This implies that the students are always comfortable with working in groups.

Table 8. Students' Attitude towards Cooperative Learning concerning Group Processing

Particular	Mean Score	Remark	Interpretation
1. After the group performance, we open up with each other on how we might improve.	3.9333	Almost Always	High

2. Improving our performance is what we are up to.	4.1810	Almost Always	High
3. We take each of the member comments to improve our next group performance, as well as ourselves.	3.9333	Almost Always	High
4. We are willing to learn brand new things to improve our performance.	4.4190	Always	Very High
OVER-ALL	4.1167	Almost Always	High

In terms of group processing, as shown in the table, the participants got a 4.1167 overall mean score which implies a high level of allowing their group members to improve their work together continuously over time.

Problem 3. Is there a significant relationship between students' attitudes about cooperative learning and their mathematics performance?

Table 9. Relationship between Students' Attitude towards Cooperative Learning and their Scores in Word Problems

Variables	Pearson's Correlation Coefficient	Pvalue	Remark
CL Attitude and Individual Score in WP	-0.110	0.264	Not Significant
CL Attitude and Group Score in WP	-0.141	0.152	Not Significant

*Significant when p-value is less than 0.05 significance level; CL = Cooperative Learning; WP = Word Problems

As shown in the table above, the p-value of cooperative learning attitude and individual score in word problems is 0.264, this implies that they have no significant relationship. The same goes with a cooperative learning attitude and group score in word problems, having a p-value of 0.152.

Problem 4. Is there a significant difference of the mathematics performance of the students before and after the cooperative learning is applied?

Table 10. Significant Difference of the Students' Scores by Group and Individual Scores

Paired Variables	Mean of the differences	Tstatistic	Degrees of Freedom	Pvalue	Remark
Group Score – Individual Score	5.305	13.780	104	0.000	Significant

*Significant when the p-value is less than 0.05 significance level

The table shows the students' scores and individual scores in the given word problems. Having the mean of the differences of 5.305 means that the group scores are way high than the individual scores of the students. And having a p-value of 0.000, implies that

there is a significant difference between the students' scores by group and individual scores.

In addition, Nichols (1996) concluded in his study (students were assigned to either a control group that received traditional

instruction and treatment groups that received cooperative learning instruction- an 83-item assessment was used as a pretest and posttest) that students receiving cooperative learning experienced increases in their intrinsic valuing of the learning task, self-efficacy, and learning goal orientations and their reported use of deep processing strategies.

V. CONCLUSIONS

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

The profile of the Grade 10 students in terms of age showed that most of the students were 16 to 17 years old and most of them were female.

The respondents got a very high level of attitude in positive interdependence and social skills, this means that the students always perceive that working together is individually and collectively beneficial, success depends on the participation of all the members; and that the students are always comfortable with working in groups. On the other hand, the remaining three elements- promotive face-to-face interaction, individual accountability, and group processing got only a high level. This implies that the students sometimes facilitate learning and contributions by each other; do not just rely on their classmates' contribution but also on theirs, and allow their group members to improve their work together continuously over time.

The study also showed that the p-value of the relationship between students' attitude towards cooperative learning and their scores in word problems by individual and by the group are 0.264 and 0.0152, respectively, which are greater than the 0.05 significance level. Thus, the two variables don't have a significant relationship.

By looking at the participants' scores, it was clearly shown that their scores increased after the cooperative learning is applied. Hence, there is a significant difference between the students' scores by group and by an individual.

Based on the results the researchers have gathered, it is therefore proven that cooperative learning is one of the best strategies or a highly recommended one in solving word problems in mathematics.

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