

## Improving Mathematics Achievement of Students with Varied Social Skills through Team-Pair-Solo Strategy (TPSS)



Jeffrey D. Del Mundo<sup>1</sup>, Hazel Jhoy C. Del Mundo<sup>2</sup>

<sup>1,2</sup> Muntinlupa National High School, PHILIPPINES

**ABSTRACT:** The study aimed to determine the effect of Team-Pair-Solo Strategy (TPSS) as a teaching strategy on the mathematics achievement of students with varied social skills. It utilized the single group pretest – posttest pre – experimental design. Through convenience sampling, one intact class consisting of 32 second year Bachelor of Arts in International Studies (BAIS) students who were enrolled at the San Beda College Alabang during the second semester of SY 2018 – 2019 was involved in the study. Seven instruments were used namely, the Mathematics Achievement Test (MAT), Social Skills Rating Scale (SSRS), TPSS Lesson Guides, TPSS Activities, and Classroom Observation Guide (COG). The result of the study revealed that the sample class was composed of three different levels of social skills based on the SSRS and these are high, moderate, and low. There is a significant difference between the MAT pretest and posttest scores of the students that indicates that the students had better scores after they were exposed to TPSS. Furthermore, there is a significant difference in the achievement of students in the posttest after their exposure to TPSS across social skills. The data results revealed that there is a significant difference between the mathematics achievement of students with high level of social skills and students with low level of social skills. The students who have high social skills outperformed those who have low social skills. Therefore, using TPSS as a teaching strategy tends to encourage students to engage in mathematics learning and helped them improve their achievement in mathematics

**KEYWORDS:** Mathematics, Achievements, Social Skills, Team-Pair-Solo Strategy

### I. INTRODUCTION

The importance of Mathematics is recognized worldwide. Mathematics is becoming progressively important in many areas including science, information technology, business and engineering. Mathematics is not just calculation but a tool for understanding structures, relationships and patterns to produce solutions to complex real-life problems.

However, even with a notion that Mathematics is truly academically relevant, most of the Filipino students are still poor in math, as revealed by the result of the Trends in Math and Science Survey (TIMSS) 2003. The Department of Science and Technology (DOST) reported that the Filipino elementary and high school students who took the TIMSS last 2003 ranked 41st in Mathematics and Science out of a field of 45 countries, significantly lower than the international average. (PHDR ISSUE: 2008/2009 No. 1)

Further, results of the National Achievement Test (NAT) in 2012 showed that the quality of mathematics education in the Philippines remains poor. The Department of Education (DepEd) data likewise showed that the average NAT score of public high school students for School Year 2011 to 2012 was below the 75% criterion. In mathematics, the fourth-year high school students obtained an average of 46.37%. This trend has been apparent for the past five years. These data show that Mathematics continues to be one of the most difficult fields of study in basic education in the Philippines.

College students are not exempted from the problem in learning and mastering mathematics. Students who have not mastered their high school mathematics also tend to fail in college. Learning mathematics is cumulative. Subsequent lessons become more difficult to learn if students missed out on some lessons. Able students are capable of diagnosing where the gap in their knowledge of their lessons exists, academically challenged students in contrast, generally cannot do this for themselves, which for them could be frustrating and leads to a feeling of not being able to cope.

Given the fact that students learn at different rates where some may be considered as advanced learners while others are quite academically challenged, educators and researchers never cease to discover better methods and strategies to deliver easier yet quality instruction particularly in Mathematics. Among the innovative theories and practical approaches being utilized

# “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

to resolve the dilemma of students' confusion and anxieties in comprehending difficult academic subjects like Mathematics is identifying the learner's Zone of Proximal Development guided by Lev Vygotsky's Social Learning Theory.

Social learning theory is a theory that suggests learning is constructed through interactions with people or the environment. The cooperative learning strategy follows this theory because its objective is to put students in small groups and have them work together to construct meaning from new information [1].

There are many strategies under cooperative learning and one of these is the Team- Pair-Solo Strategy (TPSS). TPSS is a method of cooperative learning in which the students do problem first as a team, then with a partner, and finally on their own. By applying this strategy, a teacher can encourage the students to participate in the classroom activities as well as encourage them to express their ideas without being afraid of making a mistake [2]. Among the benefits of social learning is that it serves as a venue for a more dynamic learning environment. In a social learning environment, students are free to ask questions, provide feedback, and support their peers in learning new material. Teachers act more as a facilitator in the teaching-learning process rather than the main and only source of knowledge. With this, students become more proactive as regards their own learning. Students share the mutual responsibility of comprehending the topics by themselves and working together with others that require them to advance their knowledge and skills.

This kind of interaction positively motivates students to become more responsible in their studies and to be more prepared in facing greater academic challenges [3]. Social learning environment requires students to learn from their interactions with the environment or surrounding. Lacking in social skills, a student fails to achieve and enjoy a successful educational experience. Research shows that academic performance was highly related to the possession of social skills among students. Lack of social skills has been found related to depression and anxiety and low academic achievement. Those students who are rejected by peers are lonely and have very low self-esteem and this in turn affects their academic achievement [4] . It is along this premise that the researcher attempted to experiment on the inclusion of Team-Pair-Solo Strategy (TPSS) in teaching selected topics in college algebra, and find out its effects on the mathematics achievement of the students with varied social skills.

Knowing the importance of mathematics in real-life situations, the outcome of this study is beneficial to students, teachers, and administrators. By being aware of their social skills, students may adjust their learning styles to enable them to perform better. Further, result of this study may help mathematics teachers understand their students better thus encouraging them to adapt innovative teaching strategies in the classroom. The administrators may be provided with valuable inputs in the formulation of policies that may support students in their desire to improve their performance. It is hoped that the result of this study may provide significant contribution in improving the achievement of students in mathematics and enhancing their social skills.

## II. STATEMENT OF THE PROBLEM

The study aimed to determine the effect of Team-Pair-Solo Strategy (TPSS) on the mathematics achievement of students with varied social skills. Specifically, it sought to answer the following questions:

1. What is the level of social skills of the students?
2. What is the mathematics achievement of the students before and after their exposure to Team-Pair-Solo Strategy?
3. Is there a difference in the mathematics achievement of the students before and after their exposure to Team-Pair-Solo Strategy?
4. Is there a difference in the mathematics achievement of students across social skills after their exposure to Team-Pair-Solo Strategy?
5. What is the performance of the students in the TPSS activities?

## III. METHODS

This study focused on the effect of Team-Pair-Solo Strategy (TPSS) on the mathematics achievement of students with varied social skills. The researcher utilized a single group pretest-posttest pre-experimental design. The study used quantitative and qualitative analyses. Quantitative analysis was used to determine the students' mathematics achievement and social skills by interpreting the result of the mathematics achievement test and social skills rating scale. Qualitative analysis was also used to further validate the result of the quantitative analysis on the effect of team-pair-solo strategy and the students' performance in TPSS activities. The sample in this study comprised one intact class composed of 32 students from BAIS – 2A chosen through purposive sampling. They are considered heterogeneous based on their midterm grade.

In the conduct of this study, data were collected using these instruments Mathematics Achievement Test, TPSS Activities, TPSS Lesson Guides, and Classroom Observation Guide, and Social Skills Rating Scale.

## **“Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”**

1. Mathematics Achievement Test. The MAT reliability scored 0.92 in KR-20. All items are good and fair based on difficulty index of 0.21 to 0.80 and discrimination index of 0.2 and above as the acceptable range.

2. Social Skills Rating Scale. The SSRS was adopted from Prakash [5] designed to determine the social skills of the students. The content validity of the instrument was established by seeking the expertise of the faculty from the Psychology Department of Adventist University of the Philippines. The computed reliability of the test using Kuder-Richardson Formula 20 (KR-20) was 0.81. This indicates that the SSRS is valid and reliable.

3. TPSS Activities. The researcher developed six TPSS activities (one for each lesson) based on the selected topics contained in the College Algebra course outline. These are: (1) Solving Quadratic Equations by Extracting Square Roots, (2) Factoring, (3) Completing the Square, (4) Using Quadratic Formula, (5) Solving Equations Transformable into Quadratic Equations, and (6) Applications of Quadratic Equations. The class was exposed to the different parts of the activity first as a team, then as a pair, and lastly, without a partner or solo. Each part of the activity is composed of 2 to 4 problem solving questions. The problem solving in the activities include mathematical or systematic operation regarding the six topics. The TPSS activities were incorporated in the lesson for 3 weeks. There were administered after the discussion of the teacher-researcher. The activities were face and content validated by three experts. Scoring was based on rubric using a 4-point Likert-type scale from 0 to 3, 0 being the lowest and 4 being the highest. The results of the TPSS activities were individually scored and interpreted as very good (2.4 – 3.0), good (1.6 – 2.3), fair (0.8 – 1.5) and poor (0 – 0.7).

4. TPSS Lesson Guides. The researcher developed six semi-detailed lesson guides in College Algebra incorporating the Team-Pair-Solo Strategy. These lesson plans served as guides in the conduct of the study.

5. Classroom Observation Guide. The department head and the vice dean (one at a time) observed the class during the conduct of TPSS to ensure that the researcher strictly followed the lesson guide. The observer was given orientation on the procedures and what would transpire during the TPSS. The observer was asked to answer the observation guide that interpreted as Strongly Agree (3.4-4.0), Agree (2.6 – 3.3), Disagree (1.8 – 2.5) and Strongly Disagree (1.0-1.7).

### **A. Data Gathering Procedure**

This study was conducted in four phases.

Phase I focused on the development and validation of the research instruments. The content and faced validation of the instruments was performed by experts in the field of mathematics, education, and the researcher’s adviser.

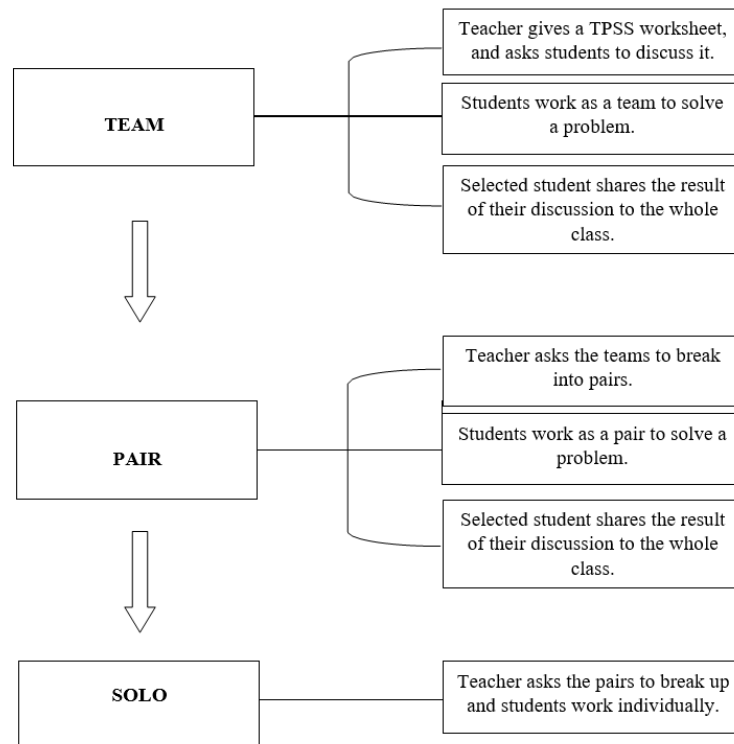
Phase II involved the orientation on the use of TPSS and the administration of the Mathematics Achievement Test (MAT) and the Social Skills Rating Scale (SSRS). The MAT was administered to the students, before their exposure to TPSS. The scores of the students in the MAT determined their achievement in college algebra. After the administration of the MAT was the administration of the SSRS. The results identified the level of social skills of the students. After the administration of the SSRS, the students were given orientation and practice about TPSS to eliminate the novelty effect. The students were assigned to their respective teams consisting of four students per team.

There were eight teams belonging to the high ability, moderate ability, and low ability students based on their grades during the midterm period of school year 2018 - 2019. Pairing was done by ranking the class from the highest to the lowest midterm grade in college algebra. After the ranking, the list was flipped in half. Students with high grades were paired to students with low grades. This means that the teams and pairs are heterogeneous.

Phase III involved the implementation of Team-Pair-Solo Strategy (TPSS). Observations of the teaching and learning process applying the TPSS by the department head and the vice dean were done during this phase. They monitored if the lessons were strictly followed using the lesson guides. During this period, the students were instructed to listen attentively to the discussion before the activity. After the discussion, the teacher gave a problem with several questions, and asked the students to discuss it with their team. Students worked as a team to be able to solve the problem based on the background knowledge prior to the activity. They discussed, shared ideas, and taught each other on how to analyse the problem and how to answer the questions posed by the teacher- researcher. After discussing for about 10 to 15 minutes, selected students shared the result of their discussion to the whole class. When all the students were done with their presentations, the teacher made generalizations and corrected their misconceptions. In the next step, the teacher asked the teams to break into pairs. Then teacher gave them a similar problem to analyse and similar questions to be answered. Students worked in pairs, discussed and shared their ideas to each other to analyse the problem and answer the questions. After discussing for about 10 to 15 minutes, selected students shared what they got to the whole class and the teacher corrected their misconceptions. The teacher asked the pairs to break up and the students worked individually. A similar problem was given to the students to analyse by using their own experiences working in team and pair. The result of the students’ work in this step was used to assess their performance in solving math

# “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

problems. The teacher moved on to the next topic and he continued until all the topic were discussed. Lesson plans and activity sheets prepared by the teacher were aligned with the course syllabus in college algebra. Figure 5 illustrates the flow on how the Team-Pair-Solo Strategy was implemented. While the Phase IV was the administration of the posttest.



**Figure 1. Flow Diagram of the Conduct of TPSS.**

## B. Data Analysis

The results of the MAT and SSRS were individually scored and totaled. The raw scores were converted to z-score. Then the z-scores were converted to stanine and each stanine score has equivalent descriptive interpretation. The level of students’ social skills was described as high (7 – 9), moderate (4 – 6), and low (1 – 3). While students’ mathematics achievement was interpreted as above average (7 – 9), average (4 – 6), and below average (1 – 3). The mean and standard deviation of the overall scores in the MAT were determined.

Inferential statistics, paired t-test was used to determine the significant difference between the means of the pretest and posttest scores in the mathematics achievement of the students, one-way ANOVA was utilized to determine the mathematics achievement of the students across social skills after using TPSS. The quantitative data were encoded using IBM SPSS Version 24 for all statistical processing and analyses. The following statistical tools were used to analyze and interpret the data and results of the study: (1) paired t-test was used to determine significant differences between the pretest and posttest scores in the MAT; and (2) one-way ANOVA was used to determine significant differences in the mathematics achievement of students across social skills. All tests of significance were evaluated at .05 alpha.

## IV. RESULT AND DISCUSSIONS

Discussion and analyses of the results of the statistical treatment employed as well as the interpretation of the results of the study which aimed to investigate the effect of Team-Pair-Solo Strategy (TPSS) as a teaching method on the mathematics achievement of the students with varied social skills.

### A. Students’ Level of Social Skills

The social skills rating scale (SSRS) was used to determine the students’ level of social skills. Table 4 presents the level of social skills of the students.

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

Table 1. *Level of social skills of the students*

Student No.	Stanine	Level of Social Skills	Student No.	Stanine	Level of Social Skills
1	7	High	17	3	Low
2	7	High	18	8	High
3	7	High	19	7	High
4	5	Moderate	20	6	Moderate
5	7	High	21	7	High
6	6	Moderate	22	5	Moderate
7	5	Moderate	23	5	Moderate
8	8	High	24	3	Low
9	7	High	25	2	Low
10	7	High	26	3	Low
11	5	Moderate	27	2	Low
12	7	High	28	2	Low
13	1	Low	29	6	Moderate
14	1	Low	30	4	Moderate
15	4	Moderate	31	4	Moderate
16	6	Moderate	32	5	Moderate

Table 1 presents the summary of the frequency and percentage distribution of the students' level of social skills based on the social skills rating scale. Stanine scores from 1 – 3 are classified as having low level of social skills, 4 – 6 as having moderate level social skills, and 7 – 9 as having high level of social skills.

Table 2. *Percentage distribution of the students' level of social skills*

Level of Social Skills	Frequency	Percentage
Low	8	25.00%
Moderate	13	40.62%
High	11	34.38%
Total	32	100%

As presented in table 2, there are three levels of social skills based on the social skills rating scale and the distribution was determined by percentage measures, 13 out of 32 or 40.62% of the students were found to have moderate level of social skills and it comprised the majority of the sample while 11 out of 32 or 34.38% were found to have high level of social skills; and 8 out of 32 or 25% were low in social skills. Social skills are behaviors that enable an individual to successfully interact with others and respond to the expectations of the society [6]. According to Mujis and Reynolds [4], social skills are primarily concerned with identification of behaviors that are needed in the successful performance of social tasks. It relates to a person's friendly personality and good non-verbal intelligence.

### B. Students' Mathematics Achievement Before and After Their Exposure to Team- Pair-Solo Strategy (TPSS)

Table 3. *Summary of students' pretest and posttest scores in the MAT*

	Highest Score	Lowest Score	Mean	Standard Deviation
Pretest	20	7	11.81	2.80
Posttest	29	15	23.13	3.99

As shown in Table 3, the highest score obtained in the pretest is 20 and the lowest is 7 while in the posttest, the highest and lowest scores are 29 and 15, respectively. The standard deviation of the posttest, 3.99, is higher than the standard deviation of the pretest, 2.80; indicating a greater spread of the posttest scores around its mean. The mean of the posttest which is 23.13 is higher than the mean of the pretest which is 11.81. This indicates that students performed better in mathematics after their exposure to TPSS. For further analysis, interpretation and comparison of scores of students in the MAT, the raw score of each student was converted to stanine score. Table 4 presents the mathematics achievement of the 32 students based on their

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

stanine scores in the pretest and posttest in the Mathematics Achievement Test. Stanine score from 1 – 3 classifies a student as having below average achievement, 4 – 6 as having average achievement and 7 – 9 as having above average achievement in mathematics.

**Table 4. Stanine scores of the students in the MAT**

Student No.	Stanine Score (Pretest)	Description	Stanine Score (Posttest)	Description
1	7	AA	8	AA
2	9	AA	7	AA
3	7	AA	7	AA
4	5	A	7	AA
5	4	A	7	AA
6	6	A	7	AA
7	7	AA	6	A
8	9	AA	5	A
9	5	A	5	A
10	5	A	7	AA
11	2	BA	5	A
12	5	A	4	A
13	2	BA	2	BA
14	4	A	6	A
15	2	BA	4	A
16	5	A	6	A
17	6	A	6	A
18	2	BA	5	A
19	6	A	5	A
20	4	A	2	BA
21	4	A	5	A
22	5	A	6	A
23	4	A	2	BA
24	7	AA	5	A
25	6	A	1	BA
26	4	A	2	BA
27	4	A	5	A
28	4	A	3	BA
29	2	BA	7	A
30	5	A	2	BA
31	6	A	1	BA
32	2	BA	4	A

Legend: AA – Above Average, A – Average, BA – Below Average

Table 4 reveals that there are 6 (18.75%) students who are below average, 20 (62.5%) students who are average, and 6 (18.75%) students who are above average in the pretest while in the posttest, there are 8, 17, and 7 students who are below average, average, and above average, respectively. There were 4 students out of 20 (20%) in the pretest who improved from average to above average in the posttest while 7 (35%) students fell from average to below average level. Nine (45%) students maintained their average level from pretest to posttest. Three of the six (50%) students maintained their above average level after the TPSS while the remaining three fell into the average achievement level. Most of the students who fell below their level were originally classified as below average during the midterm period. This shows that academically challenged students need more time to master and process the presented activity. Five out of 6 (83.33%) below average students in the pretest improved into average in the posttest. Only one student maintained his below average achievement level. It seems that the use of TPSS inside the classroom was beneficial to majority of the students. For students who are academically challenged, cooperative

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

learning seemed to help bring them up, possibly because it provides opportunities to discuss freely their learning difficulties with their peer in a friendly environment.

**Table 5. Result of the paired t-test on the students’ mathematics achievement test scores before and after their exposure to Team-Pair-Solo Strategy (TPSS)**

Mean		Mean	t-value	p-value	Interpretation
Pretest	Posttest	Difference			
11.81	23.13	11.32	15.58	0.00001	Significant

As shown in Table 5, the pretest mean is 11.81 while the posttest mean is 23.13. The mean difference between the pretest and posttest in the mathematics achievement test is 11.32. The computed *t*-value is 15.58 and the *p*-value is 0.00001 which is less than 0.05 level of significance ( $p < .05$ ), therefore there is a significant difference in the mathematics achievement of the students before and after their exposure to Team-Pair-Solo Strategy (TPSS). It means that the TPSS had a differential effect on the students’ achievement in mathematics. The result of the study is supported by Amalia [7] and Ogunleye [8] who affirmed that the effectiveness of team-pair-solo has been widely acknowledged and proved to be more effective in improving academic achievement. Team-Pair-Solo has shown significant achievement gains on mathematics tests. The same findings were observed in the study of Zakaria [9] on the effects of cooperative learning on students’ mathematics achievement. His study showed that cooperative learning methods improved students’ achievement in mathematics. He concluded that cooperative learning is an effective approach which mathematics teachers need to incorporate in their teaching. This study also confirms the findings of Hossain and Tarmizi [10], that using cooperative learning approach improves the students’ performance in mathematics. Researches on effective instruction show that achievement is higher when students are given many opportunities to respond and participate in the lessons. According to Kellough [11], cooperative learning gives an opportunity for students to learn a lesson that promotes constant participation with immediate feedback. It increases academic learning and adolescents are more willing to learn from their peers

### C. Posttest Mean Scores of Students in the MAT across Social Skills

**Table 6. Mean posttest scores of the students in the MAT across social skills**

Level of Social Skills	Mean	Standard Deviation
High	25.55	3.91
Moderate	22.46	4.33
Low	20.88	2.30

Table 6 shows that the students with high level of social skills obtained the highest mean score of 25.55 in the mathematics achievement posttest followed by the students with moderate level of social skills, 22.46. The lowest mean score was obtained by the students with low level of social skills, 20.88. The students with moderate level of social skills obtained the highest standard deviation of 4.33 in the mathematics achievement posttest; indicating a greater spread of the posttest scores around its mean. One-way ANOVA was utilized to determine the significant difference in the achievement of students in the posttest after their exposure to Team-Pair-Solo Strategy (TPSS) across social skills. Table 7 presents the result of one-way ANOVA on the overall sample of the different levels of social skills on the posttest mean scores in the MAT.

**Table 7. ANOVA result on the posttest mean scores of students in the MAT across social skills**

Source	Sum of Squares	df	Mean Square	F	p-value	Interpretation
Between Groups	110.667	2	55.333	4.170	0.026	Significant
Within Groups	384.833	29	13.270			
Total	495.500	31				

Table 7 shows that the *p*-value of 0.026 is less than the 0.05 level of significance set for the study. This indicates that there is a significant difference among students’ achievement across social skills after their exposure to TPSS. Since the *F*-ratio value is



## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

significant, a test of multiple comparisons was done specifically Tukey’s Honestly Significant Difference (HSD). The Post Hoc Test was used to determine the multiple comparisons at 0.05 level of significance of the dependent variable, the mathematics achievement after the treatment, across different levels of social skills. Table 8 presents the result of the Post Hoc Test.

**Table 8. Tukey’s HSD of posttest mean scores in the MAT across social skills**

Level of Social Skills	Mean Difference	p-value	Interpretation
High vs Moderate	3.09	0.115	Not Significant
Moderate vs Low	1.58	0.602	Not Significant
High vs Low	4.67	0.026	Significant

Table 8 shows that there is a significant difference between the mathematics achievement of students with high level of social skills and students with low level of social skills ( $p < .05$ ). This means that students with high level of social skills outperformed the students with low level of social skills. The TPSS is equally effective to students with moderate and low level of social skills. According to Hernandez [12], this reflects the social aspects of learners that by nature, teenagers wanted to be with their peers. He also stated that these students learn from each other and benefit from activities that require them to articulate and test their knowledge. Working with a group and for the benefit of the group also motivate these students. On the other hand, lack of social skills has been found as one of the factors related to anxiety and low academic achievement. Students who are rejected by peers are lonely and have very low self-esteem and these in turn affect their academic achievement. Research shows that academic achievement is highly related to the possession of social skills [4].

### D. Students’ Performance in the TPSS Activities

TPSS activities were scored by the teacher-researcher using the scoring rubric. The 32 students were divided into eight groups. The members of the groups were a combination of students who had higher midterm grade and those with lower midterm grade. There were three categories in the TPSS activities: Team, Pair, and solo. To compare the performance of the eight groups in every team activity, Table 9 shows the mean score and description of their performance.

**Table 9. Average of students’ performance in team activity 1-6**

Group	Team Activity						Average
	1	2	3	4	5	6	
1	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.77</b> <b><i>Very Good</i></b>
2	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	<b>2.67</b> <b><i>Very Good</i></b>
3	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.72</b> <b><i>Very Good</i></b>
4	3.00 <i>Very Good</i>	2.33 <i>Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.67</b> <b><i>Very Good</i></b>
5	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	3.00 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.56</b> <b><i>Very Good</i></b>
6	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	<b>2.56</b> <b><i>Very Good</i></b>
7	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	2.00 <i>Good</i>	<b>2.50</b> <b><i>Very Good</i></b>
8	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.33 <i>Good</i>	2.67 <i>Very Good</i>	2.33 <i>Very Good</i>	3.00 <i>Very Good</i>	<b>2.67</b> <b><i>Very Good</i></b>
<b>Average</b>	<b>3.00</b> <b><i>Very Good</i></b>	<b>2.71</b> <b><i>Very Good</i></b>	<b>2.71</b> <b><i>Very Good</i></b>	<b>2.75</b> <b><i>Very Good</i></b>	<b>2.54</b> <b><i>Very Good</i></b>	<b>2.13</b> <b><i>Good</i></b>	<b>2.64</b> <b><i>Very Good</i></b>

\*2.4-3 – Very Good, 1.6-2.3 – Good, 0.8-1.5 – Fair, and 0 – 0.7 – Poor

Table 9 reveals that Group 1 performed best with a mean of 2.77 and Group 7 with 2.50 performed least among other groups based on the mean score per group. Group 1 performed best possibly because the rank 1 student is included in this



## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

group. Based on the data given, the groups performed their best in the first activity (Solving Quadratic Equations by Extracting Square Roots) with a mean score of 3.00 described as very good. While they performed least in the last activity (Applications of Quadratic Equations) with a mean of 2.13 described as good. It seems that one of the factors affecting the performance of the students in the team activity is the level of difficulty of the topic. All groups have descriptions of very good in performing the team activity. The over-all average of the students’ performance in the team activity is 2.64 described as very good. The results showed that working with classmates helps students improve academically. To compare the performance of the sixteen pairs in every pair activity, Table 10 shows the mean score and description of their performance.

**Table 10. Average of students’ performance in pair activity 1-6**

Pair/ Level	Ability						Mean
	1	2	3	4	5	6	
1 (H,L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	2.50 <i>Very Good</i>	<b>2.86</b> <b>Very Good</b>
2 (A, A)	2.50 <i>Very Good</i>	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	1.67 <i>Good</i>	2.00 <i>Good</i>	<b>2.31</b> <b>Good</b>
3 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.78</b> <b>Very Good</b>
4 (A, A)	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	2.50 <i>Very Good</i>	<b>2.46</b> <b>Very Good</b>
5 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.83</b> <b>Very Good</b>
6 (A, A)	2.50 <i>Very Good</i>	2.67 <i>Very Good</i>	2.67 <i>Very Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	2.50 <i>Very Good</i>	<b>2.50</b> <b>Very Good</b>
7 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.50 <i>Very Good</i>	<b>2.92</b> <b>Very Good</b>
8 (A, A)	2.75 <i>Very Good</i>	2.00 <i>Good</i>	2.33 <i>Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	2.38 <i>Good</i>	<b>2.65</b> <b>Very Good</b>
9 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.50 <i>Very Good</i>	<b>2.92</b> <b>Very Good</b>
10 (A, A)	2.50 <i>Very Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	<b>2.47</b> <b>Very Good</b>
11 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.00 <i>Good</i>	<b>2.83</b> <b>Very Good</b>
12 (A, A)	3.00 <i>Very Good</i>	2.00 <i>Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.00 <i>Good</i>	2.00 <i>Good</i>	<b>2.45</b> <b>Very Good</b>
13 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.67 <i>Very Good</i>	2.50 <i>Very Good</i>	<b>2.81</b> <b>Very Good</b>
14 (A, A)	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	2.00 <i>Good</i>	<b>2.33</b> <b>Good</b>
15 (H, L)	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	3.00 <i>Very Good</i>	2.67 <i>Very Good</i>	2.33 <i>Good</i>	3.00 <i>Very Good</i>	<b>2.83</b> <b>Very Good</b>
16 (A, A)	2.50 <i>Very Good</i>	2.67 <i>Very Good</i>	3.00 <i>Very Good</i>	2.33 <i>Good</i>	2.00 <i>Good</i>	2.00 <i>Good</i>	<b>2.42</b> <b>Very Good</b>
<b>Average</b>	<b>2.86</b> <b>Very Good</b>	<b>2.75</b> <b>Very Good</b>	<b>2.79</b> <b>Very Good</b>	<b>2.64</b> <b>Very Good</b>	<b>2.43</b> <b>Very Good</b>	<b>2.28</b> <b>Good</b>	<b>2.63</b> <b>Very Good</b>

\*2.4-3 – Very Good, 1.6-2.3 – Good, 0.8-1.5 – Fair, and 0 – 0.7 – Poor H (High Ability), A (Average Ability), L (Low Ability)

Table 10 presents the students’ mean scores in each pair activity. Pair 7 and Pair 9 performed best in pair activities with a mean score of 2.92 described as very good while Pair 2 and Pair 14 performed least with mean scores of 2.31 and 2.33,

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

respectively described as good. It was also found out that pairs 1, 3, 5, 7, 9, 11, 13, and 15 performed better than pairs 2, 4, 6, 8, 10, 12, 14, and 16. The first eight pairs are those with high and low ability students while the next eight pairs are those with average ability students. It seems that during the pair activity, the assistance of high ability students played a vital role.

As shown in Table 10, the pairs performed their best in the first activity with a mean score of 2.86 described as very good. While they performed least in the last activity with a mean of 2.28 described as good. Activity 1 is about solving quadratic equations by extracting the square roots and activity 8 is about application of quadratic equations. It is more difficult compared to activity 1. It seems that the performance of the students in the pair activity is affected by the level of difficulty of the topic. The over-all average of the students’ performance in the pair activity is 2.63 described as very good. This result showed that working with a pair with one student having a higher ability helps students improve their problem-solving performance in mathematics.

Finally, students worked solo which means that they worked alone as individual. This process developmentally helps the students to have a progress from the point in which they could do only with help to they can do alone. To compare the performance of the 32 students in every solo activity, Table 11 shows the mean score and description of their performance.

**Table 11. Average of students’ performance in solo activity 1-6**

Student/ Ability Level	Solo Activity						Mean	Description
	1	2	3	4	5	6		
1 (H)	3.00	3.00	3.00	3.00	3.00	3.00	<b>3.00</b>	<i>Very Good</i>
32 (A)	2.25	2.00	2.33	2.33	2.00	2.00	<b>2.15</b>	<i>Good</i>
9 (A)	3.00	3.00	3.00	3.00	2.33	2.00	<b>2.72</b>	<i>Very Good</i>
24 (L)	2.50	3.00	2.67	2.00	2.33	2.00	<b>2.42</b>	<i>Very Good</i>
2 (H)	3.00	3.00	3.00	3.00	3.00	3.00	<b>3.00</b>	<i>Very Good</i>
31 (A)	2.50	2.33	2.33	2.33	2.33	2.00	<b>2.30</b>	<i>Good</i>
12 (A)	2.50	3.00	3.00	2.00	2.33	2.00	<b>2.47</b>	<i>Very Good</i>
21 (L)	3.00	2.67	2.33	2.33	2.33	2.00	<b>2.44</b>	<i>Very Good</i>
3 (H)	3.00	3.00	3.00	3.00	3.00	3.00	<b>3.00</b>	<i>Very Good</i>
30 (A)	2.25	2.33	2.00	2.00	2.00	2.00	<b>2.10</b>	<i>Good</i>
14 (A)	3.00	3.00	3.00	2.67	2.67	2.50	<b>2.81</b>	<i>Very Good</i>
19 (L)	2.75	3.00	3.00	2.33	2.67	2.50	<b>2.71</b>	<i>Very Good</i>
4 (H)	3.00	3.00	3.00	3.00	3.00	3.00	<b>3.00</b>	<i>Very Good</i>
29 (A)	3.00	3.00	2.33	2.33	2.00	2.00	<b>2.44</b>	<i>Very Good</i>
16 (A)	2.75	2.67	3.00	2.33	2.33	2.00	<b>2.51</b>	<i>Very Good</i>
17 (L)	2.50	2.33	2.33	2.67	2.33	2.00	<b>2.36</b>	<i>Good</i>
5 (H)	3.00	3.00	3.00	3.00	3.00	3.00	<b>3.00</b>	<i>Very Good</i>
28 (A)	2.50	3.00	3.00	2.33	2.00	2.00	<b>2.47</b>	<i>Very Good</i>
15 (A)	2.50	2.67	3.00	2.67	3.00	2.00	<b>2.64</b>	<i>Very Good</i>
18 (L)	3.00	3.00	2.67	2.67	2.33	3.00	<b>2.78</b>	<i>Very Good</i>
6 (H)	3.00	3.00	3.00	3.00	3.00	2.00	<b>2.83</b>	<i>Very Good</i>
27 (A)	3.00	3.00	1.67	2.00	2.00	2.00	<b>2.28</b>	<i>Good</i>
13 (A)	3.00	2.33	2.33	2.67	2.33	2.00	<b>2.44</b>	<i>Very Good</i>
20 (L)	3.00	2.67	2.33	3.00	2.33	3.00	<b>2.72</b>	<i>Very Good</i>
7 (H)	3.00	3.00	3.00	2.67	2.67	3.00	<b>2.89</b>	<i>Very Good</i>
26 (A)	2.50	3.00	2.67	1.67	2.33	2.50	<b>2.45</b>	<i>Very Good</i>
10 (A)	3.00	3.00	2.33	2.67	2.33	2.00	<b>2.56</b>	<i>Very Good</i>
23 (L)	2.50	2.67	2.67	2.00	2.33	2.00	<b>2.36</b>	<i>Good</i>
8 (H)	3.00	3.00	3.00	3.00	2.67	2.50	<b>2.86</b>	<i>Very Good</i>
25 (A)	3.00	3.00	2.00	2.33	2.00	2.00	<b>2.39</b>	<i>Good</i>

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

11 (A)	2.50	2.67	2.67	2.67	2.33	2.50	<b>2.56</b>	<b>Very Good</b>
22 (L)	2.50	3.00	2.33	2.00	2.33	2.50	<b>2.44</b>	<b>Very Good</b>
<b>Average</b>	<b>2.78</b>	<b>2.82</b>	<b>2.66</b>	<b>2.52</b>	<b>2.45</b>	<b>2.34</b>	<b>2.60</b>	<b>Very Good</b>

\*2.4-3 – Very Good, 1.6-2.3 – Good, 0.8-1.5 – Fair, and 0 – 0.7 – Poor

Table 11 shows the mean scores of the students in the solo activities. Based on the results, Students 1, 2, 3, 4, and 5 got the highest mean score of 3.00 (very good) in the solo activities. Students 7, 8, and 6 got the next highest mean score of 2.89, 2.86, and 2.83, respectively (very good) in the activities. These eight students made good progress in solving math problems. These students are the high achievers during the midterm period; they were also the leaders of their respective teams. On the other hand, Student 30 obtained the lowest mean score of 2.10 (good) in the solo activities. Student 32 followed with a score of 2.15 in the solo activities. Three students (26, 28, 29) belonging to the low ability level were very good in the solo activities while five students (25, 27, 30, 31, and 32) were good. Of the 16 average level students, 14 or 87% were very good and only 2 or 12% were good in the solo activities. The over-all average of the students’ performance in the solo activities is 2.60 described as very good. It implies that TPSS helped students develop their problem-solving performance in mathematics. The high ability students shared their knowledge to the low ability students that is why when the low ability students worked independently, they performed well. The pairs consisting of average ability students complemented each other so that when they were not in pairs, they also performed well. These results are supported by Kellough [11]. He stated that achievement is higher when students are given many opportunities to participate in the lessons. He also stated that cooperative learning increases academic learning and students are more willing to learn from their classmates.

To describe the performance of the students in the TPSS activities, the mean score was used. Table 12 presents the mean scores of the students in the TPSS activities.

**Table 12. Mean scores in the three categories of students’ performance in the TPSS activities**

Group	Category			Average
	Team (n = 1)	Pair (n = 2)	Solo (n = 4)	
	Mean	Mean	Mean	
1	2.77 <i>Very Good</i>	2.59 <i>Very Good</i>	2.57 <i>Very Good</i>	<b>2.64 <i>Very Good</i></b>
2	2.67 <i>Very Good</i>	2.6 <i>Very Good</i>	2.55 <i>Very Good</i>	<b>2.61 <i>Very Good</i></b>
3	2.72 <i>Very Good</i>	2.67 <i>Very Good</i>	2.66 <i>Very Good</i>	<b>2.68 <i>Very Good</i></b>
4	2.67 <i>Very Good</i>	2.65 <i>Very Good</i>	2.58 <i>Very Good</i>	<b>2.63 <i>Very Good</i></b>
5	2.56 <i>Very Good</i>	2.7 <i>Very Good</i>	2.72 <i>Very Good</i>	<b>2.66 <i>Very Good</i></b>
6	2.56 <i>Very Good</i>	2.64 <i>Very Good</i>	2.57 <i>Very Good</i>	<b>2.59 <i>Very Good</i></b>
7	2.5 <i>Very Good</i>	2.57 <i>Very Good</i>	2.57 <i>Very Good</i>	<b>2.55 <i>Very Good</i></b>
8	2.67 <i>Very Good</i>	2.63 <i>Very Good</i>	2.56 <i>Very Good</i>	<b>2.62 <i>Very Good</i></b>
<b>Average</b>	<b>2.64 <i>Very Good</i></b>	<b>2.63 <i>Very Good</i></b>	<b>2.60 <i>Very Good</i></b>	<b>2.62 <i>Very Good</i></b>

\*2.4-3 – Very Good, 1.6-2.3 – Good, 0.8-1.5 – Fair, and 0 – 0.7 – Poor

Table 12 reveals that Group 3 performed best with a mean of 2.68 and Group 7 with 2.55 performed least among other groups based on the mean score per group while Group 5 and 1 followed with means of 2.66 and 2.64, respectively. All groups have description of *very good* in performing the TPSS activities. Based on the data given, the groups performed their best in the first category which is *Team* with a mean score of 2.64 described as *very good*. While *pair* and *solo* have mean scores of 2.63 and 2.60, respectively also described as *very good*. The over-all average of the students’ performance is 2.62 described as *very good*. It means that the students performed better when they were involved in a cooperative learning environment.

For further analysis in comparing the work of Group 3 and Group 7, Table 16 shows the social skills level of Group 3 and Group 7 before their exposure to TPSS. Result revealed that there were 2 students who have high level of social skills in Group 3, 1 student who is moderate, and 1 student who is low in social skills while in Group 7, there were 1, 2, and 1 student who have high, moderate, and low social skills, respectively. It shows that before the exposure to TPSS Group 3 has more students with

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

high social skills level than Group 7. As revealed in the quantitative analysis students with high social skills outperformed those with low social skills.

Table 13 also reveals that there were 3 students who have average ability in the pretest in both Group 3 and Group 7, and 1 student who is above average. This indicates that before the exposure to TPSS students from Group 3 and Group 7 have the same ability level. After their exposure to TPSS, there was a decrease in the number of students under the average ability level in Group 7, there was 1 student who improved into above average while there were 2 students who fell into the below average level. And the above average student fell into the average level. This decrease in the ability level after exposure to TPSS could explain why Group 7 performed the least but it is still in the range of very good.

**Table 13. Summary of the level of social skills, pretest score and posttest score ability level of Group 3 and Group 7**

Group	Student No.	Level of Social Skills	Pretest Score Ability Level	Posttest Score Ability Level
GROUP 3	3	High	Above Average	Above Average
	30	Moderate	Average	Below Average
	14	Low	Average	Average
	19	High	Average	Average
GROUP 7	7	Moderate	Above Average	Average
	26	Low	Average	Below Average
	10	High	Average	Above Average
	12	Moderate	Average	Below Average

Although the MAT raw scores of all the members of Group 7 improved (from 8 to 24, 12 to 27, 13 to 26, 12 to 25, respectively), Group 3 scored better (from 17 to 24, 8 to 22, 8 to 27, 15 to 28, respectively) than Group 7. Student 7 is the leader of Group 7, he is considered as a high ability student during the midterm period and yet he belonged to the least performing group, he said “...I am not yet ready to be the leader of my team. But my group members helped me specially Dominic and I gained points for my team by answering the activities.” The assigned leader in Group 7 encountered difficulties while doing the TPSS, and it could be one of the reasons why they performed last in the TPSS activities. Besides, Student 7 has moderate social skills. Student 26 fell into below average in the posttest from average in the pretest. According to him, he struggled in answering the solo activities because he is not good in mathematics. He also said “... I found difficulty in answering the solo part of the activity because the time is very short. I cannot answer the worksheet in just 10 – 15 minutes because I am slow in solving math problems.” Which indicates that he found it difficult because of time pressure.

On the other hand, student 10 improved into above average in the posttest. His insights about TPSS is “...we had roles during the activity. We were required to fulfill our responsibilities in order to understand the topic and be successful in the presentation”. He expressed that cooperation was important in order to be successful in the group activity. Students 10 had positive experience about TPSS.

Student 3 of Group 3 is classified as *High* in social skills level. She is categorized as above average in the pretest and posttest in the MAT. Her insight about TPSS is “...being the leader of the group, I am the one who are responsible to my teammates. I need to help them passed the activities. It is also the way on how will I improve my skills”. She is a responsible leader and she felt that TPSS enhanced her mathematical skills by working together. Student 14 added “The activities improved my math skills because my teammates helped me to correct my miscalculations and minor errors.” According to student 19, TPSS activities helped them to perform better in mathematics because they learned from each other. He also said “mas gusto ko na ngayon na lagi na akong may kasama magsagot kasi sobrang nakakatulong sila (groupmates)”. Student 30 fell into below average in the posttest. Her insight about TPSS is “... I learned a lot from my groupmates. The activity helps me to improve my skills in solving math problems... Madalas nahihirapan pa din ako kasi takot ako sa math. Pero masaya ako kasi dahil sa mga kagroupmates ko nakakasagot na ako. Sana lagi na lang groupwork ang activity sa math.” Despite of having a low score in the TPSS activities, she still wants TPSS activities to be used in learning mathematics. As the highest performing group, Group 3 recommended the TPSS “...because we can able to brainstorm and share some ideas within our group. It helps the topic easier to understand” and “because my group mates are also helping me to understand even though we encounter some difficulties in other topics”. These

## “Improving Mathematics Achievement of Students with Varied Social Skills Through Team-Pair-Solo Strategy (TPSS)”

findings about team-pair-solo strategy concur with the studies of Amalia [7] and Ogunleye [8] who established that the strategy is associated with better learning process.

### V. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the study, the use of Team-Pair-Solo Strategy (TPSS) tends to improve the mathematics achievement of the students. The sample class was composed of three different levels of social skills based on the Social Skills Rating Scale (SSRS) and these are high, moderate, and low. The use of Team-Pair-Solo Strategy (TPSS) favoured the students with high level of social skills. This study recommend that Team-Pair-Solo Strategy (TPSS) may be used as a teaching method in improving students' achievement not only in mathematics but also in other subjects. Social skills of the students be assessed at the beginning of the school year to complement teaching strategies, approaches, and assessments. Furthermore, this study be replicated using larger samples and longer period of time to further evaluate its effectiveness and application in learning mathematics as a teaching strategy. Similar studies be conducted on the use of Team-Pair-Solo Strategy using other variables not included in the study such as attitude, anxiety, learning style, and self- esteem to improve the achievement of the students in mathematics.

### REFERENCES

- 1) Hubble, E., Kuhn, M., & Malenoski, K. (2007). Using technology with classroom instruction that works. Alexandria, VA: ASCD.
- 2) Cook, J. (2007). Effective teaching strategies that work with all students, Session Willimantic: EASTCONN.
- 3) Diez, E. (2015.) Operationalization of activity-based learning strategies In teaching college algebra. Unpublished Master's Thesis. The National Teachers College, Manila.
- 4) Mujis, D. & Reynolds, D. (2005). Effective teaching. (2nd ed.). Sage Publications.
- 5) Prakash, R. (2007). Effect of peer tutoring strategy on mathematics achievement and social skills of college algebra students. Unpublished Master's Thesis. Adventist University of the Philippines. Puting Kahoy, Silang, Cavite.
- 6) Loreman, T. (2005). Inclusive education – a practical guide to supporting diversity in the classroom. Routledge Falmer.
- 7) Amalia, R. (2011). The use of team-pair-solo in reading comprehension (a pre- experimental research in XI grade students of SMA negeri 4 semarang in the academic year of 2010 – 2011. Semarang State University.
- 8) Ogunleye, B. (2011). The effects of “Team Pair Solo” (TPS) cooperative learning strategy and students' personality type on achievement in Chemistry. University of Ibadan, Nigeria.
- 9) Zakaria, E. (2010). The effects of cooperative learning on students' achievement and attitude towards mathematics. Science Publication. Journal of Social Sciences 6. Vol. 2.
- 10) Hossain, A. & Tarmizi, R. (2013). Effects of cooperative learning on students' achievement and attitudes in secondary mathematics. Bangladesh.
- 11) Kellough, G. (2002). Teaching in the middle and secondary school. (7th ed). Merrill Prentice Hall.
- 12) Hernandez, A. (2007). Comparative study on learning styles of selected public and private schools in Dasmariñas. Unpublished Master's Thesis, The National Teachers College.



There is an Open Access article, distributed under the term of the Creative Commons Attribution–Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.