

# Problem Solving Approach to the Performance and Attitude in College Algebra of College Students

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**Abstract**—The aim of this study is to determine the effects of problem-solving approach on the performance in and attitude of freshmen college students towards College Algebra. In the study, the Pretest-Posttest Control group design was utilized which involved two matched groups of respondents – the experimental group and the control group. The relevant concepts in selected topics in College Algebra were taught to the experimental group using the problem-solving approach, while the conventional approach in teaching and learning was employed to the control group. The research study was conducted during the first semester of school year 2014-2015. Necessary data were gathered through the achievement test, attitude scale questionnaire in College Algebra, form 138, and College Admission Test results sheet. The data gathered were managed using frequency counts, percentages, means, paired and t-test. The results of the analyses showed that the implementation of the problem solving approach in teaching College Algebra had positively affected and improved the performance of the respondents. It was also found out that the utilization of the problem-solving approach in the delivery of instruction in College Algebra had positively contributed to the development and reinforcement of a favorable attitude towards the subject.

**Index Terms**— Problem-solving approach, Performance, Attitude, College Algebra, Effective teaching approaches, College students,

## 1 INTRODUCTION

ACCORDING to Akinoglu and Tandogan [1], merely telling is not teaching and simply listening is not learning. This suggests that learning should be an active process.

In all active learning processes, Ali [2] mentioned that the students shift from passive listeners and information receivers to active, well-engaged learners, and problem solvers. The objective of learning is to actively engage students in group work and in individual study. The learners' self-directed learning gives them the freedom to decide individually and consciously on the learning strategy that helps them accomplish the task. The problem-solving approach in teaching mathematics manifests these key features of active learning process.

Teaching through problem-solving has become a major focus in mathematics education as it helps students develop mathematical knowledge and provides a chance to apply and connect previously learned mathematical concepts and skills.

SAIDE [3] emphasized that mathematics, to be fully understood by the students, should be taught in a way that understanding the subject is a result of solving problems, rather than teaching the students how to understand it.

Problem solving approach is defined as an approach in teaching in which the students learn the mathematical concepts by engaging themselves in a problem-solving task or activity in which the required solutions and processes are not obviously known. As such, students need to explore on the concepts, develop understanding of the problem, and make connections with mathematical knowledge previously learned, and select appropriate mathematical skill that leads to the solution of the problem.

The problem-solving approach places students into

the center of the teaching and learning process. It also provides opportunities to develop active and motivated learning, problem-solving skills, and broad field knowledge. In this approach, students are responsible of their own learning as they are left for some time to understand the problem and to arrive at the solution using appropriate mathematical skills and knowledge. This can be done individually, by pair or by a small-group discussion.

Teaching through problem-solving focuses attention on ideas and sense-making. It helps students develop mathematical concepts indicated in the posed problems. Problem solving also develops mathematical power among students. They learn how to recognize what knowledge and skills are necessary in solving the problem. Thus, students see the connections between the previously learned mathematical concepts and the skills needed to solve the current problem. This skill is vital in overcoming various challenges in their lives and since the students are given enough time to work on the problem, they are at the same time developing confidence in doing mathematics.

Generally, teaching through problem solving emphasizes that important mathematics concepts and procedures can be best taught through problem solving task or activities which engage students in thinking about the important mathematical concepts and skills they need to learn. Hence, this does not only impact the development of students' higher-order thinking skills but also reinforce positive attitudes [4].

In a classroom where the problem solving approach is utilized, the teacher poses a thought-provoking problem which may require hands-on activities, illustrations, paper and pencil, or mental mathematics. The teacher allows the

students to work on the problem individually, by pair or by group, within a given period of time. The students struggle to solve the problem through concept exploration, inquiry, and application of necessary prior and basic mathematics concepts and skills. After the time has elapsed, students present their ideas or solutions to the class. Each student is given an opportunity to ask questions or to clarify an idea. This allows active discussion to happen until the class has arrived at the correct solution to the problem, hence, learning the concept. Then, the teacher gives a summary of the concepts attached to the problem. Afterwards, students are given similar problems to work on where they apply the concepts and skills they have just learned.

Taplin [5] enumerates the three types of problems to which students should be exposed. One is word problems where the concept is embedded in a real-world situation and the students are required to recognize and apply the appropriate rule. This type of problem helps prepare the students for the challenges of life. On the other hand, the non-routine problems require a higher degree of interpretation and organization of the information in the problem, rather than simply applying the rule. Non-routine problems encourage the development of general knowledge and common sense. The third type is real problems which are concerned with investigating a problem which is real to the students and do not necessarily require a fixed solution and use mathematics as a tool to find the solution. This provides students the opportunity to engage themselves in the society through service.

The success of the problem-solving approach depends on the teacher and the students. Teachers need to believe that the focus of learning should be conceptual, rather than procedural. They should also recognize that there is much more to a problem than the answer. Teachers then should recognize that making mistakes is an integral part of learning. On the other hand, students should also recognize that working hard with a problem will ultimately lead to a solution. This can help them view mathematics as a subject which they can actually learn on their own. Allowing student to solve the problem by group enhances their perseverance. Students tend to persevere in solving the problem when they are interacting with their fellow classmates [6].

The focus of this study was to determine the effectiveness of problem solving approach in enhancing the performance and attitude of college students in College Algebra.

Two groups of respondents, the control group and experimental group, were subjected to two different methodologies in teaching and learning College Algebra. They both underwent the same set of pre-tests before going into a conventional approach in teaching and learning for the control group and problem solving approach for the experimental group. Also, an attitudinal questionnaire was admin-

istered to both groups of respondents to gauge their attitude towards College Algebra. The respondents in each group were matched based on the last three variables in the input to ensure comparability between the members of the two groups of respondents.

After the desired duration of the study, a posttest and an attitudinal questionnaire were administered to both groups. The results of the posttest and the questionnaire determined the effects of problem solving approach to the performance and attitude of college students in College Algebra.

### 1.1 Statement of the Problem

This study aimed to determine how the problem solving approach affected the performance and attitude of college students in College Algebra.

Specifically, it answered the following questions: a) What is the profile of the respondents as to Final grade in Mathematics IV, Mathematics score in the College Admission Test; and IQ score in the College Admission Test?; b) What is the performance in the pre-test and post-test in College Algebra of the experimental group with the use of problem solving approach and the control group with the use of conventional approach?; c) What is the level of attitude of the respondents towards College Algebra before and after the experiment/study?; d) Is there a significant difference between the pretest and posttest scores of the respondents in the experimental group and in the control group, the post-test scores of the experimental group and the control group, and the mean gain score of the experimental group and the control group?; and e) Is there a significant difference between the attitude of the respondents towards College Algebra before and after the experiment?

## 2 METHODOLOGY

### 2.1 Research Design

The study is experimental in nature which utilized the Pre-test-Posttest Control group design.

The control group was taught in College Algebra using the conventional approach, while the problem solving approach was used for the experimental group.

The control group and the experimental group were determined based on the result of tossing a coin. Each respondent in the control group was matched to the respondents in the experimental group on the bases of their final grade in Mathematics IV and their scores in Mathematics and IQ tests in the College Admission Test. Only twenty pairs of respondents were considered in this study. The students from the two sections who were not selected as part of the study underwent the same learning procedures as their classmates.

Only topics in College Algebra within the first half of the first semester of school year 2014-2015 were included in this study which lasted for two and one-half months.

### 2.2 Sources of Data

Data were gathered from the two groups of respondents – the experimental group and the control group, through a researcher-made pretest-posttest instrument and an adopted attitudinal questionnaire.

### 2.3 Instrumentation

To gather the needed data for the performance in College Algebra of the respondents, a 50-item multiple-choice researcher-made test covering the topics included in the duration of the study was administered. The test instrument was used to diagnose the respondents' prior knowledge on the topics and to assess how much knowledge each group has gained after the duration of the study.

An attitudinal questionnaire [7] consisting of 30 items, was utilized to determine the respondents' personal feelings and attitude towards the subject. The questionnaire was composed of positive and negative attitudes. The questionnaire was administered before and after the conduct of the study.

The raw scores in Mathematics and IQ tests of the respondents were gathered from the College Admission Test Results released by the Guidance and Counseling unit of the campus. Their grades in Mathematics IV were taken from the photocopy of their report card which was submitted to their respective department chairperson during the enrolment for the semester.

### 2.4 Analysis of Data

Frequency counts and percentages were used in analyzing the profile of the respondents and their scores in the pretest-posttest.

Because the attitudinal questionnaire was composed of positive and negative attitudes towards the subject, reverse scoring was employed for negative items, as shown in table 1 below.

TABLE 1  
 SCORING SYSTEM FOR THE RESPONDENTS' ATTITUDES TOWARDS COLLEGE ALGEBRA

Description	Score	
	Positive	Negative
Strongly Agree	5	1
Agree	4	2
Undecided	3	3
Disagree	2	4
Strongly Disagree	1	5

The weighted mean of the responses of the respondents regarding their attitudes towards College Algebra was calculated and described using the verbal descriptions below:

<b>Weighted Mean</b>	<b>Description</b>
4.20 – 5.00	Very Favorable

3.40 – 4.19	Favorable
2.60 – 3.39	Neutral/Average
1.80 – 2.59	Unfavorable
1.00 – 1.79	Very Unfavorable

The paired sample t-test using the SPSS software was used to determine whether or not there is a significant difference between the pre-test scores, post-test scores, and mean gain scores between and among the experimental group and the control group. The same statistical tool was employed in determining the difference between the attitude of the two groups of respondents towards College Algebra before and after the conduct of the study.

## 3 RESULTS AND DISCUSSIONS

### Profile of the Respondents

#### Final Grade in Mathematics IV

Table 2 presents the summary of the final grade in Mathematics IV of the respondents during their secondary level education.

TABLE 2  
 RESPONDENTS' FINAL GRADE IN MATHEMATICS IV

Grade Range	Experimental Group		Control Group	
	frequency	%	frequency	%
76 – 80	3	15%	3	15%
81 – 85	9	45%	8	50%
86 – 90	7	35%	6	30%
91 – 95	1	5%	3	15%
Total	20	100%	20	100%

It can be deduced from the table that most of the respondents, both in the experimental and control groups, had obtained a grade of 81 and above. A total of 85% of the respondents from each group received a grade that ranges from 81 to 95.

Moreover, only 3 or 15% of the respondents from each group achieved a grade that ranges from 76-80.

The table further indicates that the respondents satisfactorily complied with the requirements of their mathematics subject and thus have achieved a passing grade.

#### Raw Scores in Mathematics and IQ in the College Admission Test

The raw scores of the respondents in Mathematics and IQ tests in the College Admission Test (CAT) administered by the guidance and counseling unit of the DMMMSU-SLUC were also considered as part of the respondents' profile. The Mathematics test and the IQ test are composed of 50 items and 75 items, respectively. The test items are in multiple-choice format.

The data gathered from the two test categories

served as benchmark data in matching the two groups of respondents, in addition to their final grade in Mathematics IV. Results of the data management procedures are presented in frequencies and percentages in table 3 and table 4.

As to the respondents' scores in the Mathematics test, 100% of the respondents in the experimental group got a score that is higher than half the total test items.

**TABLE 3**  
**RESPONDENTS' RAW SCORE IN MATHEMATICS TEST IN THE COLLEGE ADMISSION TEST**

Grade Range	Experimental Group		Control Group	
	frequency	%	frequency	%
16 – 30	0	0%	1	5%
31 – 45	9	45%	12	60%
46 – 60	11	55%	7	35%
Total	20	100%	20	100%

A total of 55% or 11 respondents obtained a score that falls under the score bracket of 46 – 60. The remaining 45% of the respondents obtained a score that ranges from 31 – 45.

As for the control group, 95% of the respondents achieved a score from 31 to 60. Only 5% or 1 respondent got a score that falls under the 16 – 30 score bracket.

The results of the Mathematics test in the CAT imply that the two groups of respondents are comparable in terms of the mathematical concepts, skills and competencies integrated in the examination.

As for the scores of the respondents in the IQ test, it can be seen in table 4 that the scores of the two groups of respondents cluster at the score ranges of 31 – 45 and 46 – 60. Out of 75 items, 9 or 45% and 11 or 55% of the respondents in the experimental group respectively fall under the said score brackets.

**TABLE 4**  
**RESPONDENTS' RAW SCORE IN IQ TEST IN THE COLLEGE ADMISSION TEST**

Grade Range	Experimental Group		Control Group	
	frequency	%	frequency	%
31 – 45	9	45%	12	60%
46 – 60	11	55%	8	40%
Total	20	100%	20	100%

On the other hand, 12 or 60% and 8 or 40% of the respondents in the control group have scores that range from 31 – 45 and 46 – 60, respectively.

None of the respondents from both groups obtained a score lower than 31 or higher than 60.

These data further implies that the scores of the two groups of respondents are very close to each other as indicated in the results of the IQ test.

In addition, the analyses of the data on the respondents' grades in Mathematics IV and scores in Mathematics and IQ tests in the CAT revealed that the two groups of respondents are matched and comparable. Data indicate that both study groups were equated and made equivalent by the researcher before the experimental activity.

**Performance in College Algebra**

Table 5 indicates the performances in College Algebra of the two groups of respondents before and after the conduct of this study based on their scores in the pretest and posttest.

The pretest determined the respondents' prior knowledge of the mathematical concepts and skills related to the topics included in the duration of the study. On the other hand, the posttest determined how much of these skills and concepts were mastered by the respondents.

**TABLE 5**  
**RESPONDENTS' PERFORMANCE IN COLLEGE ALGEBRA**

Grade Range	Experimental Group		Control Group	
	Pretest (Frequency, percentage)	Pretest (Frequency, percentage)	Pretest (Frequency, percentage)	Pretest (Frequency, percentage)
0 – 10	0, 0%	0, 0%	1, 5%	1, 5%
11 – 20	5, 25%	1, 5%	15, 75%	14, 70%
21 – 30	12, 60%	7, 35%	3, 15%	3, 15%
31 – 40	3, 15%	11, 55%	1, 5%	1, 5%
41 – 50	0, 0%	1, 5%	0, 0%	1, 5%
Total	20, 100%	20, 100%	20, 100%	20, 100%
Mean Gain Score	7.70		2.75	

For the experimental group, it can be noted that the number of respondents who got a score ranging from 11 – 20 decreased by 4. From 5 or 25% who belong to this score range prior to the implementation of the study, there was only 1 or 5% who belong to this range after the duration of the study. From 60% in the pretest, there was only 35% of the respondents who got a score from 21 to 30 in the posttest. In addition, the number of respondents who got 31 to 40 items correctly in the test increased from 15% in the pretest to 35% in the posttest. Only 5% of the respondents in the experimental group indicates a score of 41 to 50 in the posttest, from 0% in the pretest. Most respondents' scores in the pretest were doubled in the posttest. Generally, the experimental group gained an average score of 7.70 in the posttest.

The problem solving activities helped the respondent-



ents recognize what appropriate knowledge and skills are necessary in solving the given problem. These engaged students in thinking about the important mathematical concepts and skill they need to learn or solve the problem [4]. Thus, they see the connections between the previously learned mathematical concepts and the skills needed to solve the current problem.

Because the respondents are given enough time to work on the problem individually, by pair, or by group, they gradually develop understanding of the process involved in problem solving and they also develop confidence in doing mathematics. Thus, problem solving approach aids in the development of the respondents' critical thinking and problem-solving skill as reflected in their performance in the post-test.

The problem-solving approach in teaching mathematics has helped the experimental group improved their performance. The approach has provided them interactive ways to learn the necessary concepts and skills integrated in the problem solving activities through focused-group discussion.

On the other hand, the numerical observations in Table 5 with the performance of the control group in the posttest showed no remarkable improvement as compared to their scores in the pre-test. The performance of the control group in the pre-test and post-test are almost the same. Most of the respondents in the control group, equivalent to 15 or 75%, obtained a score of 11 – 20 in the pre-test, while 70% of them achieved the same score range in the post-test. Only 1 or 5% had a score of 41 – 50 in the pre-test.

In general, the control group has an average mean gain score of 2.75 in the posttest.

These findings might have been due to the fact that the control group was taught using the conventional or traditional mode of instructional delivery which is characterized by chalk and board, more teacher talk, and less students' participation or classroom engagement. This supports the conclusion of Alegria [8] that nothing will change in the performance of students if innovation is not included in the teaching-learning competencies, especially by the teachers. According to her, teachers need to use varied instructional methods, techniques, and approaches to enhance students' active participation and strengthen their grasp of the important concepts and skills related to the topic.

### **Attitude towards College Algebra of the Experimental Group**

Prior to the conduct of the study, the experimental group has a neutral attitude towards 28 out of 30 indicators in the questionnaire. The item that describes College Algebra as an interesting, stimulating, and challenging subject obtained the

highest weighted mean of 3.25. The following indicators with weighted mean of 3.20 are also rated Neutral by the experimental group: (1) College Algebra enables them to think clearly; (2) College Algebra encourages them to think and try harder; and (3) College Algebra is easy to understand because the teacher is competent.

Moreover, the respondents do not favor the many rules and processes involved in College Algebra and they are unable to recognize the practical applications of the topics to real life.

Generally, the experimental group had a neutral attitude towards College Algebra prior to the implementation of the study.

However, a remarkable improvement on the attitude of the experimental group towards College Algebra can be noted after they were exposed to problem-solving approach as the main instructional method in teaching the subject.

The respondents gained a very favorable attitude to 10 indicators in the questionnaire. The respondents have learned to like the College Algebra (with weighted mean of 4.55) because it is interesting, challenging, and stimulating. The subject also allows them to think critically by pushing them to work and think (4.50). Also, the competence of the teacher helped them gain a positive attitude towards College Algebra. Further, the respondents recognized the importance of the subject in acquiring the ability to think logically and to reason out accurately.

These findings indicate that the problem solving approach does not only impact the development of the respondents competence in mathematics but also the development or strengthening of positive attitude towards College Algebra, in particular, and Mathematics, in general.

The problem solving activities that utilized real life situations and integrated practical applications of mathematical concepts to real life had influenced the respondents in enhancing and reinforcing a positive attitude towards the subject.

The respondents also recognize the advantage of working on a word problem in pairs or in small group as it provides opportunity for exchanging of ideas, hence, the development of their understanding of the necessary mathematical concepts. Consequently, this aided the respondents to be actively engaged during the assessment of each group's output characterized by brainstorming and active classroom discussion since they are confident that their ideas which they developed during the focused-group discussion or problem-solving proper are relevant to fully understand the solution to the given problem.

The respondents also gained mathematical power enabling them to solve mathematical problems on their own during individual work. As a result, they have achieved confidence in performing problem-solving activities which less-

ened their anxiety towards College Algebra.

In general, the experimental group had a favorable attitude towards College Algebra at the end of the conduct of this study, as reflected in the general weighted mean of their responses equivalent to 3.63. These figures show a notable improvement in the performance of the experimental group.

**Attitude towards College Algebra of the Control Group**

Prior to the conduct of the study, 18 indicators are rated with neutral attitude by the control group to be absolutely true of their feeling of acceptance of College Algebra based on the weighted mean of their responses which range from 2.60 to 3.39. The respondents believe that their favorable or unfavorable attitude towards the subject depends on the teacher’s ability to explain the lessons.

Although the control group remained halfway between positive and negative attitude towards College Algebra in most of the indicators, it still highly recognizes the subject’s potential to develop patience and perseverance among them as it enables them to try and work harder. This is indicated in the weighted mean of their responses in indicator 7 equivalent to 4.30, verbally described as very favorable.

The control group also expresses favorable attitude on indicator 1 stating that College Algebra is interesting, stimulating, and challenging. It can be noted that both groups of respondents recognize this characteristic of the subject.

In general, the control group has a neutral feeling of acceptance of the subject College Algebra as indicated in their responses’ general weighted mean of 3.19.

After the conduct of the study, indicators 1 and 7 achieved the highest rating, both equivalent to 4.25, verbally described as very favorable. The control group still views College Algebra as interesting, stimulating, and challenging subject. The control group recognizes the potential of the subject to push them to work and try harder.

The control group’s favorable attitude towards the subject is also influenced by the ability of the teacher to explain the topic, as seen in their rating for indicator 8 equivalent to 4.05. It may also be affected by considering this subject as their favorite subject as viewed in indicator 19 with weighted mean of 4.00.

Indicator 15 obtained the lowest weighted mean of 2.00 which indicates the respondents’ disagreement. The respondents in the control group do not view College Algebra as important subject as they do not recognize its relevant applications to real life.

Overall, the control group retained its neutral attitude towards College Algebra at the end of the duration of the study. Their responses’ weighted mean is 3.38.

This finding might have been affected by the fact

that the respondents were not introduced to any teaching methods that would engage them actively and would enable them to work together with their classmates. In the traditional method of teaching employed in their section, their role is just to receive information and to answer questions when asked by the teacher.

**Difference in the Pretest and Posttest Scores of the Respondents**

It has been discussed earlier in table 5 that the performance of the experimental and control groups in the pretest and posttest. The results showed that the posttest scores of the respondents from both groups increased as compared from their scores in the pretest.

The next table shows the analysis results whether the improvement in the performance of the respondents in the posttest is significant.

The scores of the two groups of respondents were subjected to paired t-test using the SPSS software.

**TABLE 6  
 TEST OF DIFFERENCE IN THE PRETEST SCORES OF THE RESPONDENTS**

Group	t-value	p-value	Decision
Experimental	5.328	0.000	Significant
Control	2.258	0.038	Significant

As seen on the table, the performance in the pretest and posttest of the experimental group is highly significant. This is indicated in the equivalent p-value of 0.000 which is lower than the 0.05 level of significance. This means that the experimental group has substantially increased their knowledge and skills in as far as the content coverage of the study is concerned. This is evident in the difference of their pretest and posttest scores as reflected in Appendix A. It can be noted that most of the respondents have doubled their scores in the posttest.

The problem solving approach has evidently provided the experimental group with an effective method of learning the related algebraic concepts and skills through working on a set of problem solving activities, whether individually or by pairs.

As for the respondents in the control group, the results of the analysis imply that they have considerably gained competence in terms of knowledge and skills in performing word problems in Algebra. The results reveal that the posttest scores of the control group increased significantly.

From the results, it can be noted that the control group has gained a considerable amount of understanding and mastery of the related algebraic concepts and skills through the traditional approach in teaching mathematics.

However, the increased in the scores of the control groups is not as high as that of the experimental group. The statistics points out that the experimental group performed better. Thus, their performance is more enhanced compared to the control group.

Since problem solving approach provides opportunities for collaborative learning, this affirms the results of the study of Romney as stated by Albay [8] on collaborative learning that students in a collaborative classroom setting are pleased to be able to share their difficulties with others, they gain confidence from observing that if their teammates can solve problems, they will also be able to overcome them. In addition, "collaborative learning experiences promote higher achievement than do competitive and individualistic experiences". Thus, working together in a collaborative setting results in a greater understanding than would likely have occurred if one had worked independently [8].

**Comparative Analysis of the Posttest and Mean Gain Scores of the Respondents**

An analysis of the performances of the experimental and control groups in the posttest was also conducted to determine if a significant difference exists.

TABLE 7  
 TEST OF DIFFERENCE IN THE POSTTEST AND MEAN GAIN SCORES OF THE RESPONDENTS

Group	t-value	p-value	Decision
Posttest	4.794	0.000	Significant
Mean Gain	2.660	0.011	Significant

The results of the t-test between the post-test scores of the respondents posit a computed t-value of 4.794, with an equivalent p-value of 0.000. Because the p-value is lower than the 0.05 significance level of this study, it can be concluded that the posttest scores of the two groups are significantly different. The respondents' individual scores in Appendix A indicate that the experimental group obtained higher scores in the posttest than the control group. Thus, the experimental group performed better than the control group.

The findings imply that the problem solving approach in teaching enabled the experimental group to achieve a higher rate of mastery of the relevant concepts and skills integrated in the lessons in College Algebra.

**Comparative Analysis of the Attitude towards College Algebra of the Respondents**

Prior to the implementation of the study, the two groups of respondents were given an attitudinal questionnaire that gauges their feelings towards College Algebra. The same questionnaire was administered to them at the end of the set

duration of the study. The weighted mean of their responses were compared to determine whether or not there is an improvement in their attitude towards College Algebra. The results of the analysis using paired sample t-test through the SPSS software were reflected in table 8 below.

The table reveals that the experimental group exhibited a significant change in their attitude towards College Algebra. This is indicated in the t-value between the means of their responses equivalent to -7.410 with corresponding p-value of 0.000.

Initially, the experimental group's attitude towards the subject falls halfway between negative and positive acceptance. Their feeling towards College Algebra is a balanced mix of positive and negative attitude. However after the duration of the study, the weighted mean of the responses of the experimental group was categorized as favorable. Therefore, it can be noted that their attitude towards the subject significantly improved.

This result of the analysis may be attributed to the interactive and collaborative learning environment that was enabled by the problem solving approach in teaching College Algebra. The experimental group was provided with opportunities to discuss important previously learned mathematical concepts integrated in the problem solving activities and to brainstorm on the steps to be carried out to arrive at the correct solutions.

TABLE 8  
 DIFFERENCE IN THE ATTITUDE TOWARDS COLLEGE ALGEBRA OF THE RESPONDENTS

Group	t-value	p-value	Decision
Experimental	7.410	0.000	Significant
Control	1.343	0.195	Not Significant

The approach had helped them gain mathematical power and confidence in performing problems solving tasks that led to the enhancement and development of a more positive attitude towards College Algebra.

On the other hand, the table further shows that the attitude towards College Algebra of the control group did not significantly change. It can be noted that the computed t-value of their responses' weighted mean equivalent to 1.343 corresponds to p-value of 0.195 which is higher than the level of significance of this study. This statistics indicates that there was no significant improvement in the attitude of the control group towards College Algebra.

It was discussed earlier that the control group remained to have a neutral attitude towards the subject after the study. This may have been caused by the lack of relevant teaching intervention introduced to the group. The respondents of the control group were taught using the conventional method of teaching mathematics where the students serve as

receiver of information. Primarily, the teacher discusses the lesson and then provides a set of activities to the respondents at the end of his/her discussion. The control group was not given opportunities for exploration, interaction, and collaboration. The learning environment of the control group was dominated by the teacher.

### 3 CONCLUSIONS

Both the experimental group and the control group have passed their secondary mathematics and obtained a grade point average that is higher than the minimum passing grade. The respondents from both groups got at least half of the total items correctly in Mathematics and IQ tests in the College Admission test.

The experimental group obtained higher scores in the posttest than the control group.

The experimental group gained a favorable attitude towards College Algebra after the conduct of the study. The control group, however, remained neutral towards the subject.

Both groups of respondents improved their performance after the experiment. However, the experimental group performed better in the posttest than the control group. Thus, the problem solving approach helped enhance the performance in College Algebra of the experimental group.

The experimental group gained a more positive attitude towards College Algebra than the control group.

### 4 RECOMMENDATIONS

Mathematics teachers may consider historical data regarding the performance of their students in their previous mathematics subjects and other allied disciplines. These can serve as input that will enable teachers to devise a learning plan of activities that suit best to the characteristics of their students.

Mathematics teachers may venture on the use of various collaborative approaches in teaching mathematics, such as the problem solving approach, to improve the performance of their students in the said subject.

Since developing a positive attitude towards mathematics among the students is critical for mathematics teachers, it is necessary for teachers to have a repertoire of best teaching practices that can be used to provide quality mathematics instruction and to enable students to be actively engaged in the learning process.

The problem solving approach in teaching College Algebra and other fields in Mathematics may be employed by mathematics teachers at all levels of education to develop students' mathematical power. Teachers may accompany this approach with appropriate instructional materials in order to improve the conceptual understanding and problem-solving ability of their students.

The problem solving approach is a potential tool in helping students overcome their anxiety towards mathematics subjects. Thus, teachers may consider attending to seminars or review educational materials that focus on the nature and procedures in the effective implementation of the said teaching approach. This will enable them to effectively employ the said approach in the delivery of mathematics instruction in the classroom setting.

### 7.1 Appendix

Indicators in the attitudinal questionnaire [9].

1. College Algebra is stimulating, interesting, and challenging.
2. College Algebra is fascinating, enjoyable, and fun.
3. I like College Algebra because the topics are their applications to real life are fascinating.
4. This subject makes me feel uncomfortable, restless, irritated, and impatient.
5. My mind goes blank and I am unable to think clearly when working with this subject.
6. It makes me nervous to even think about having to do Algebraic problems.
7. This subject encourages me to think and try harder.
8. I cannot understand this subject because the teacher cannot explain well.
9. I am always under a terrible strain in this Mathematics class.
10. I feel hesitant to work with College Algebra because I fear of not being able to do it well.
11. I feel at ease in this subject and I enjoy it very much.
12. I do not like this subject; I wish I could take another subject.
13. This subject makes me feel as though I was lost in a jungle numbers and I could not find my way out.
14. I find this subject easy to understand.
15. This Mathematics subject is important to me.
16. I am happier in my College Algebra class than in any other subject.
17. I am confident that I can solve problems in College Algebra.
18. I like this subject because it develops my ability to think and reason out accurately.
19. College Algebra is my most hated subject.
20. I hate this subject because my teacher is strict, that I feel nervous through out the period.
21. College Algebra is boring.
22. I do not like the many rules used in this subject.
23. I hate this subject because of the many exercises and assignments.
24. This is my favorite subject.
25. I like this subject because the practices make me understand the lesson better.
26. I like College Algebra because it is not an ordinary one.
27. It is time-consuming to study this subject.
28. The rules and processes in this subject are complicated and confusing.
29. I enjoy analyzing College Algebra problems.
30. I feel a definite positive reaction towards College Algebra.

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