Student Team Achievement Division (STAD) in Teaching Trigonometry in Mindoro State College of Agriculture and Technology Bongabong Campus

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***Abstract*—** Trigonometry is one of the branches of mathematics that are taught in the curricula. The students need to comprehend and master this subject because of its application in real life situation. Just like other math subjects, some students find this subject complex and difficult to understand. With this, the researcher was motivated to conduct this study to help students overcome those difficulties. This study aimed to determine the effectiveness of Student Team Achievement Division (STAD) in teaching Trigonometry in Mindoro State College of Agriculture and Technology – Bongabong Campus. Quasi-experimental design was utilized in this study to two groups of Second Year students. The control group was taught using the traditional teaching approach while the experimental group was taught using STAD. A comprehensive test previously tested and validated was used as the data gathering tool in the study. Pre-test and posttest were administered to both groups of participants. The data was treated using Mean, Frequency – percentage, Standard Deviation, and ttest for independent samples. The result of the study showed that student under the experimental group performed better than those in control group. Further, there is a significant difference between the performance of the participants in experimental and control group. Based from the study, the STAD is effective in teaching Trigonometry.

***Keywords*—** quasi experiment, student team achievement division, Trigonometry, traditional teaching, students' performance

I. INTRODUCTION

Mathematics is one subject that pervades life at any age, in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject, therefore, must be learned comprehensively and with much depth. In spite its importance, a number of students are scared of Math and struggle in their Math subject for so many reasons. It is therefore a mission and a challenge to Mathematics teachers to make their students like Mathematics and later on love it.

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There are various branches of Mathematics that needs to be learned by students. All of them have various and relevant applications to real-life situation. Trigonometry is one of the branches of mathematics with wide application in real life situation. Among its application includes bullet trajectory in ballistics, blood splatters in criminal investigation, bearing in navigation, distance of celestial objects in astronomy, length of sound wave in music, dimension of mountains, ocean, etc. in geography, computer games development, and wide application in engineering, Physics, architecture, medicine, flight engineering, archaeology, marine biology, marine engineering. It is in these sense that this subject should be understood and master by the students for this will greatly help them in the future to whatever endeavour they would pursue. Thus, finding ways to effectively teach the subject is of great importance, hence, this study was conducted.

Mathematics teachers are constantly utilizing various teaching strategies in order for their students to improve their performance in Mathematics. The teaching strategies perceived to be most effective by Science and Mathematics teachers of schools identified as benchmarks in teaching and learning practices were: hands-on experience that bring students to their fullest learning capacity because they depend on themselves, cooperative learning because they can share better knowledge when they work in groups rather than when they work alone, and self-discovery because it enhances students' learning capability [1].

According to Slavin [2], cooperative approach requires the students to cooperate with one another to learn. The students are also responsible on the learning of their group as well as their own learning. This method also emphasizes on achieving group's goals and groups' success which can be achieved when all group members have learned the intended objectives.

Cooperative learning increases students' participation to class discussions and helps slow learners to understand topics easily. It also enhances understanding and self-confidence. Incorporating cooperative learning in the mathematics classroom would enhance the learning of mathematics in secondary schools. Implementation of jigsaw cooperative learning should be reviewed in terms of knowledge and skills of each teacher. Training and continuous professional

development is needed for teachers, and collaboration among teachers should be encouraged through holding regular meetings, both formal and informal. Teachers can learn from each other and can examine the strengths and weaknesses of the instruction that has been implemented, and their experience can be shared with each other to produce better work [3].

There are numerous studies that show positive effect of cooperative learning method on Mathematics performance. Ali, Seyed, Manijeh and Hasan [4] and Arsaythamby & Chairhany [5], have shown that there are significant changes between the pretest and posttest in cooperative learning group. Students who learn in a group with cooperative learning are more active [6], they are in a relaxed learning situation which encouraged them to be more forward in asking questions as a group, rather than as individual [7]. In cooperative learning, students have the ability to compete and cooperate until they become active and creative in the learning process [8]. Further, the use of cooperative learning was associated with an increase in the performance of the students in the test provided that the students are taught how to work cooperatively together [7].

In this study, the researcher focused only in collaborative learning using STAD model. Through collaborative learning, students are more likely to learn by sharing ideas with small groups and work collaboratively to complete academic task [1].

A. Performance in Mathematics.

According to the international test called Trends and International Mathematics and Science Study (TIMSS), the performance of the Philippine students in the international standardized exams in math is among the lowest in the world [9]. As of the latest result that the country joined the study, the Philippines ranked 34th out of 38 countries in High School Mathematics and ranked last (10th) in Advanced Mathematics [10].

B. Collaborative/Cooperative Learning Approach.

Collaborative Learning Approach is a currently emerged approach that involves a structured group of learners working together toward a shared goal based on a fixed procedure [11, 12]. In a collaborative work, students are asked to actively participate, interact, explain and socialize [13, 14]. Everyone should take over and use the different skills to create a comfortable context to communicate freely and openly with each other [15]. Cooperative learning is an efficient instructional technique for a variety learners in a variety of situations [16]. According to Arney [17], the most successful groups are probably groups of three and are formed by either considering their location or interest. The students are more likely to succeed because they are exposed to more types of approaches to a concept or a lesson. They are more likely to gain exposure to the type that works for them. The use of groups inside and outside the classroom assisted in the student's understanding of the material and gave them additional confidence in their abilities to truly learn math. Working with groups contributes to the improvement of students' attitudes towards mathematics and have positive effect on students' achievement. Working with groups can help to encourage students to be more involved with one another [18].

C. Student Team Achievement Division (STAD).

STAD stands for Student Team Achievement Divisions, it is a collaborative learning strategy in which a small groups of learners with different levels of ability work together to accomplish a shared learning goal. It was devised by Robert Slavin and his associates at Johns Hopkins University [19], students are assigned to four or five member learning teams that are mixed in performance level, gender, and ethnicity. It can unite the learning group to improve Mathematics achievements by concept comprehension and communication [20].

D. Collaborative learning, STAD and Math.

Various studies showed that STAD Model affects the students' performance in Mathematics. Keramati [21] found that students taught using STAD technique are more successful than control group students. Similarly, a study conducted by Yu [22] found that subject in the cooperative learning tend to have a higher scores on both the post test and attitudes toward science course. STAD makes students active participants in the classroom and allows them to work together as a small family whose sole aim is to make his family succeed [23]. Collaborative learning encourages students to interact with one another to increase their ability to process information [2, 12], enhances students' understanding and confidence in Mathematics [24]. They feel contented when they can function effectively in the group work [25]. Teachers need to be aware of the benefits and importance of cooperative learning and thus, changing the practice of teacher-centered teaching methods to student-centered teaching methods. Teachers need to master the mathematical content to be delivered and plan how to implement cooperative learning better. Cooperative learning should be employed especially STAD so that students can help each other in small groups [26].

II. Methodology

A. Objectives of the Study

This study aimed to determine the effectiveness of using STAD Model in teaching Trigonometry to Third Year Education students of Mindoro State College of Agriculture and Technology.

Specifically, this aimed to:

1. determine the level of performance of the control group and the experimental group during the pretest and posttest;
2. determine whether there is a significant difference on the performances of the control and experimental group in the pre-test and post-test.

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B. Research Design

Quasi experiment was utilized in this study. To determine the effectiveness of using STAD model in teaching Trigonometry, two groups were formed and compared. The first group was taught using traditional method called the control group and the second group was taught using STAD model regarded as the experimental group.

C. Participants, Sampling and Setting

The sixty students from Second Year were the participants of this study. To avoid selection bias, the researcher utilized stratified random sampling wherein she categorized the students as above average, average and below average based from their average grade in major subjects during the previous semester. Equal number of participants coming from the three strata was distributed between the two groups involved in the study so that each group have thirty participants. The students under the experimental group were categorized into four quartiles. Each team is composed of a member from the first, second, third and fourth quartile to ensure heterogeneity of the groups.

D. Data Collection and Analysis

The research instrument used in the study was a comprehensive test comprised of 10-item multiple choice type of test per chapter. The said instrument was validated and pretested for its reliability. A pretest were given prior to the actual teaching of the lesson. After each chapter, posttest were administered to the participants. This is a three-month study covering only five (5) chapters.

The scores of the participants in the pre and posttest were tabulated. To treat the data, mean, frequency percentage and standard deviation were applied. Further, the ttest was employed to test the hypotheses of the study. Ttest is the most appropriate tool of inferential statistics for it is a robust parametric that yields significant statistics and helps compare sample means of two different groups taken randomly from a population [27, 28].

E. Experimental Set Up (STAD Model)

The control group was subjected to the traditional lecture-discussion method which aims to transmit knowledge mainly through lecturing and the use of visual aids. On the other hand, the experimental group used the STAD model of cooperative learning method which has four phases:

Phase I: Teach (Class Preparation)

Teacher's Role: The teacher facilitated the group learning starting with the group organization, continued with teamwork building and monitoring the students' learning.

Students' Role: Students need to be active and responsible for their own learning. Promoting within the group and peer teaching were accomplished.

Phase II. Team Study

Team members worked together to learn the concept but work independently on answering the problems. Students shared and explain their answer with the group.

Phase III. Test

Students took test independently and were not allowed to help each other. The average score of the group were taken to represent the rating of each group member.

Test IV: Team Recognition

The teacher recognized the work of each team by means of bulletin board that reported the ranking of each team within the class. Incentives and prizes were also given.

F. Result and Discussion

Identifying the students' performance in Trigonometry

The posttest mean score of 6.55 (SD = 1.60) of students in the control group is greater than their pretest mean score of 3.71 (SD = 1.23). The difference between the two tests was significant as the t (29) = 14.6646, $p<0.05$ which revealed that the students gained knowledge through traditional method.

On the other hand, the posttest mean score (8.52, SD = 1.04) of the students taught using STAD model was higher than their pretest mean score of 4.29 (SD = 1.02). As such, utilization of STAD model positively affects the students' performance in Trigonometry as t(29) = 24.53445, $p<0.05$.

TABLE I
PERFORMANCE OF THE CONTROL AND EXPERIMENTAL GROUP IN PRETEST AND POSTTEST

Tests	n	Mean	SD	t
Control Group				
Pretest	30	3.71	1.23	14.6646*
Posttest	30	6.55	1.60	
Experimental Group				
Pretest	30	4.29	1.02	24.5345*
Posttest	30	8.52	1.04	

Comparing the pretest scores of the experimental and control group

In comparing the performance of the participants during the pretest, students under the control group showed lower mean score of 3.71 (SD = 1.23) than those under experimental group (4.29, SD = 1.02). However, not significant result could be found as t (29) = 1.3163, $p>0.05$ which denotes that there is no significant difference. The result reveals that the prior knowledge of the two groups of participants are of the same level.

TABLE II
COMPARISON BETWEEN THE PERFORMANCES OF THE CONTROL AND EXPERIMENTAL GROUP IN THE PRETEST AND POSTTEST

Tests	n	Mean	SD	t
Pretest				
Control	30	3.71	1.23	1.3163
Experimental	30	4.29	1.02	
Posttest				
Control	30	6.55	1.60	10.2512*
Experimental	30	8.52	1.04	

The mean score in the posttest of the students taught using STAD (8.52, SD = 1.04) was greater than those taught using traditional method (6.55, SD = 1.60). Further, a significant difference between the performances in Trigonometry of the two groups of respondents exists as t (29) = 10.2512, $p<0.05$. Thus, STAD model is effective in teaching Trigonometry.

III. Conclusion

The students under STAD model performed better than those under traditional method. Also, the students under STAD model increase their interest in Trigonometry and they were able to develop their social relationship with each other. They become more responsible with their learning as well as the learning of their peers. Thus, STAD model in teaching Trigonometry is effective.

Findings of this study revealed that collaborative learning through STAD model has significant effect on the students' performance in Trigonometry. The experimental group shows significant improvement on their posttest scores compared to that of the control group. The result suggest that the increase in the students' performance was attributed to the significant effect of STAD model. The findings of this study, therefore, are consistent with the results reported by Boudehane (2015), Keramati (2009), Yu (1998), Curtis (2009), Hossain (2013), Chin (2010), Ali et al (2007), Arsaythamby & Chairhany (2012) and Zakaria (2013). Further, the study also compared the students' performance under traditional teaching and STAD model which found out that students taught using STAD model performed better than those taught using traditional method. This finding was congruent with that of Arney (2010) because students who were exposed to more types of approaches tend to truly learn math. Working together in small groups will help them achieve the common goal [18] through effective classroom management [29]. Through collaborative learning, students exhibit higher level of academic achievement, deeper understanding of learned material, more positive and supportive relationship with peers, and better critical thinking skills and problem solving skills [30, 31]. Students when exposed to collaborative learning become more active [6], more involved [4], more forward [7], confident [24], competitive and creative [8].

After the conduct of the study, the students taught using STAD model understand the concepts of Trigonometry and their applications to various disciplines better than those under traditional method. Because of working with peers they were able to gain confidence and improve their social aspect. They too also appreciate the applications and importance of probability in their daily lives.

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