

# Assessing the Effectiveness of STAD Model and Problem Based Learning in Mathematics Learning Achievement and Problem Solving Ability

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## Abstract

The objective of this study was to compare the effectiveness of teaching methods in improving Mathematics Learning Achievement and Problem solving ability of students at an international college. This is a Quasi-Experimental Research which was done the study with the first year students who have registered to study Mathematics subject at St. Theresa International College of Thailand. The experiment was conducted in the first semester of the academic year 2015 in two classes; each classroom consisted of 25 students was chosen using Cluster Random Sampling. The statistical tools used for the study were Mean, Standard Deviation and One-Way ANCOVA a covariance analysis. The study results revealed that, among the 2 teaching methods, the students groups taught through STAD model of cooperative learning have secured high scores in the post-test conducted to measure mathematics learning achievement and problem solving ability. Hence there is a significant difference between the teaching methods, mathematical learning achievement and problem solving ability. However, both the methods have improvement in post-test, further it is evidenced that STAD model of cooperative learning is effective compared to problem based learning for improving students in mathematics.

**Keywords:** STAD model of cooperative learning; problem based learning; Mathematics learning achievement, problem solving ability

## 1. Introduction

Mathematics has significant role towards the development of human thoughts. It initiates ideas to think logically and systematically. And helps to analyze problems or situations thoroughly, prudently and it helps in hypothesize, planning, decision making, problem solving and can be utilized in daily life properly (Ministry of Education 2008:1). Hence, as in accordance with the National Education Act of 1999, which aim to manage Mathematics learning process to focus on developing learners in both learning achievement and problem solving ability for students (Jun Tiyawong).

However, Mathematics is the subject that deals only with the numbers and it distracts learners' interest to study; besides it is a boring subject. To achieve in Mathematics teaching, thus, teachers should prepare their teaching subjects with psychological method which should be in accordance with each student behavior by looking for some odd and new methods or different ways of teaching to teach students (Department of Curriculum and Instruction Development 2001: 65 - 66).

Cooperative Learning is the teaching model that is popular and is widely used by overseas countries, such as United States of America, England, Australia, Norway and Israel (Suree Bower, cited in Rasica Saimanee, 2004). The Cooperative-Based Learning crucially focus on students by using group process to allow learners to have opportunity to work together and as a result can mutually obtain benefits and achievement for groups. Although, the Cooperative-Based Learning not only let learners work in group, for example, but also make them to prepare reports, do new creative activities, discussion, do experiment and teacher is the one that summarizes the results, but teachers should try to use some strategies to let learners codify the different activities that came from processes by themselves. It is essential that students should manage knowledge summarization system by themselves (Pimphan Dechacoop, 200: 15).

Five Models of cooperative-based learning were developed and evaluated at John Hopkins University by Center for social organization of schools. As cited in (Slavin & Cooper, 1999), they are Student-Teams Achievement Divisions (STAD), Teams-Games-Tournament (TGT) (Slavin, Leavy, & Madden, 1984), Cooperative Integrated Reading and Composition (CIRC; Stevens, Madden, Slavin, & Famish, 1987), Team Assisted Individualization (TAI; Slavin, Leavy, & Madden, 1984), JIGSAW (Aronson, Blaney, Stephan, Sikes,

& Snapp, 1978, which was evaluated and widely used and also as modified by Slavin (1986). The four models are adjustable to use for all subjects and levels that has enough qualification to work in group. But, the CIRC model could be used for reading and writing (Slavin, 1983). For learning management using the Cooperative-Based Learning by using the STAD technique (Student Teams Achievement Divisions) is one of the procedures that appropriately use the learning and teaching management which mainly focus on students. Hence, learning management begins from teachers to provide knowledge to learners by using appropriate context by allowing students to have more roles in activities (Anongnat Sermsiri, n.d.)

From the comparative research study of learning achievement with the Cooperative-Based Learning in a normal classroom, found that the Cooperative-Based Learning helps students in high level of learning achievement (Slavin, Medden and Stevens, 1989:22) which correspond to the research work of (Ali Reza Jalilifar, 2010) that studied students comprehension in reading efficiency using Cooperative-Based Learning. The results revealed that learning using STAD technique has more efficiency in improving students' achievement.

Recently at St. Theresa International College the teaching and learning of Mathematics are conducted through Problem Based Learning model and found that it has elevated to one level only. However, the College desires to elevate students' learning achievement and students' problem solving ability to a higher level. Therefore, the College lecturers had been engaged in Cooperative-Based Learning by using STAD model and brought the process for the application in learning Mathematics. By doing so, if it really works in lifting up students learning achievement and if students can solve problems, then perhaps will increase students' standard to the equivalent international capabilities. Hence based on the above scope the researchers are interested to study the mathematics learning achievement and problem solving ability of students by using STAD model of Cooperative based learning and to compare the results with problem based learning of mathematics.

### 1.1 Research Objectives

- ✚ To compare the effectiveness of STAD model of cooperative learning and Problem based learning in Mathematics Learning Achievement of the students at International College.
- ✚ To compare the effectiveness of STAD model of cooperative learning and Problem based learning in improving problem solving ability of the students at International College.

### 1.2 Research Hypothesis

#### Null Hypothesis

- ✚ There is no significant difference among students with respect to STAD model and Problem based learning in mathematics learning achievement.
- ✚ There is no significant difference among students with respect to STAD model and problem based learning in improving problem solving ability.

## 2. Research Methodology

This research followed Quasi Experiment design which has the research form of Randomized Control-Group Pretest-Posttest Design models.

### 2.1. Population and Sampling Group

The Population of the study is first year students of St. Theresa International College, Thailand, who were enrolled to study Mathematics. By the first semester of Academic Year 2015, there were 12 classes and each class had 25 students. The 300 students were assembled together and two classes were selected randomly; each class consisted of 25 students. Later, it was assigned as experimental group (25 students) and control group (25 students). Experimental group was tested with STAD model of cooperative learning, whereas control group was tested with problem based learning. Pretest-Posttest design models were adopted for both the groups.

## 2. Variables

**2.1 Independent Variable:** Teaching Method is the independent variable. There were 2 teaching methods as follows:

- 2.1.1 Experimental Group was tested with STAD model of Cooperative-Based Learning.
- 2.1.2 Control Group was tested with Problem Based Learning.

### 2.2 Dependent Variables

Variables used in the study were Mathematics Learning Achievement and Problem Solving Ability.

3. The information used for this test was based on the curriculum of Bachelor Degree in Mathematics, accordance with the Office of the Higher Education Commission.

4. Statistical tools used in this research: Statistical tools used in this study were Descriptive Statistics and the Analysis of Covariance (ANCOVA).

5. Time frame of the study: June – October 2015.

### 3. Study Procedures

In this study, researcher has collected and tested data from the first semester of Academic Year 2015 by the following processes:

1. Firstly, the researchers did orientation to students in order to indicate the learning activity and did the pre-test. For this purpose, the researchers created 40 multiple choice questions with 4 choices to assess the Mathematics Learning Achievement and the Problem Solving Ability of the students.
2. Secondly, activities were conducted as in accordance with the learning plan of the STAD model of Cooperative Learning, which consisted of 16 plans for 16 hours. Similarly, problem based learning activities also carried out with 16 plans for 16 hours, equally.
3. Thirdly, the test was conducted after class by using the test forms related to Mathematics Learning Achievement and Problem Solving Ability.
4. Finally, the results of mathematics learning achievement and problem solving ability would be compared with respect to STAD model of cooperative learning and problem based learning.

### 4. Analysis and Interpretation

The results of the study are presented as follows:

#### 1. The Mathematics Learning Achievement Marks

The marks of Mathematics Learning Achievement of international students are shown in Table No. 1.

**Table No. 1** The marks of Mathematics Learning Achievement of international students taught through using STAD model and problem based learning

Groups	N	Marks before		Marks after	
		Average Value	S.D.	Average Value	S.D.
Teaching through Problem Based Learning	25	22.480	1.610	26.000	1.290
Teaching through STAD model of Cooperative Learning	25	23.960	1.337	28.080	1.605

From the table 1, it is inferred that Mathematics Learning Achievement of students in both the groups taught through Problem Based Learning and STAD model of Cooperative-Based Learning secured high scores than before. Further, it was also found that the marks of the Mathematics Learning Achievement of students in both the group secured high marks even before learning through STAD Model and Problem based learning. However, Mathematics Learning Achievement was found high in one Group, which taught through STAD model of cooperative learning compared to problem based learning. Hence, it is obvious that effectiveness of STAD model is high in attaining mathematics learning achievement.

#### 2. Scores of Problem Solving Ability

The marks of Problem Solving Ability of international students are shown in Table No. 2.

**Table No. 2.** The marks of problem solving ability of international students taught through using STAD model and problem based learning

Groups	n	Marks before		Marks after	
		Average Value	S.D.	Average Value	S.D.
Teaching through Problem Based Learning	25	20.400	.957	24.360	.952
Teaching through STAD model of Cooperative-Based Learning	25	21.240	1.200	33.960	1.767

From the table 2, it is inferred that the average marks scored by students in problem solving ability is high in both the groups, before and after learning through different methods. In general, the students scored high marks after learning through problem based learning and STAD model of cooperative learning. However, when compared with two teaching methods, the students scored high marks that taught through STAD model of cooperative learning. A huge difference in scores was observed between two teaching methods and hence it can be concluded that STAD model of cooperative learning have high impact in improving problem solving ability of students.

### 3. The Comparison of teaching methods and problem solving ability

A One-Way ANCOVA was conducted to determine a statistically significant difference between teaching methods (groups learnt through STAD Model and Problem-Based Learning) and problem solving ability, covariance is problem solving ability scores before they are taught using specific methods.

**Null Hypothesis:** There is no significant effect of teaching methods on students' problem solving ability, controlled by their scores before they are taught under specific methods.

**Table No. 3. One-Way ANCOVA comparison of covariance**

Source	df.	SS.	MS.	F	P
Problem Solving Ability before taught using specific teaching methods	1	9.781	9.781	4.993*	.030
The teaching methods	1	32.390	32.390	16.539**	.000
Error	47	92.059	1.959		
Total	50	36714.000			

R Squared = .410 Adjusted R Squared = .384

\*p < .05 \*\* p < .01

The results of One-Way ANCOVA indicates that there is a significant effect of teaching methods on problem solving ability of the students after controlling their normal scores of problem solving ability, before taught using the specific methods (F, 4.993), P<0.05 and after using teaching methods (F, 16.539), P<0.01 with 1 degrees of freedom respectively. The larger F-Value indicates that the results would be significant. And the model fit at R-Square value 41%, which indicates there is a large amount of variation in scores of students and there is a linear relationship between teaching methods and problem solving ability. Hence it can be concluded that there is a significant difference between the teaching methods (STAD model of cooperative learning and Problem based learning) and problem solving ability of students.

### 4. The comparison of teaching methods and Mathematics learning achievement of international students

A One-Way ANCOVA was conducted to determine a statistically significant difference between mathematics learning achievement scores before and after using teaching methods (groups learnt through STAD Model and Problem-Based Learning); covariance is mathematics learning achievement scores before they are taught using specific methods.

**Null Hypothesis:** There is no significant effect of teaching methods on students' mathematics learning achievement, controlled by their scores before they are taught under specific methods.

**Table No. 4 One-Way ANCOVA comparison of covariance**

Source	df.	SS.	MS.	F	P
Mathematics Learning Achievement before taught using specific methods	1	1.519	1.519	.750	.391
Teaching Methods	1	880.542	880.542	434.716**	.000
Error	47	95.210	2.026		
Total	50	43764.000			

R Squared = .924 Adjusted R Squared = .921

\*p < .05 \*\* p < .01

The results of One-Way ANCOVA indicates that there is a significant effect of teaching methods on Mathematics learning achievement of the students after controlling their normal scores of mathematics learning achievement before taught using the specific methods, (F, .750), P>0.05 and after using the methods (F, 434.716), P<0.01 with 1 degrees of freedom respectively. The larger F-Value of teaching methods indicates that the results are significant after using the teaching methods, when compared to before. And the model is fit at R-Square value 92%, which indicates there is a linear relationship between mathematics learning achievement and teaching methods. Hence it can be concluded that there is a significant difference between the teaching methods (STAD model of cooperative learning and Problem based learning) and Mathematics learning achievement of the students.

## 5. Summary of Study Results

- ✚ The students group that was taught using the STAD model of cooperative-based learning had secured high scores in Mathematics learning achievement than the students group who have taught using the problem based learning.
- ✚ The students group that was taught using the STAD model of cooperative-based learning had secured high scores in problem solving ability than students group who have taught using the Problem Based Learning.
- ✚ There is a significant difference between teaching methods (STAD model of cooperative learning and problem based learning) and problem solving ability of students before taught using teaching methods.
- ✚ There is a significant difference between teaching methods (STAD model of cooperative learning and problem based learning) and mathematics learning achievement of students before taught using teaching methods.

## 6. Discussion

- ✚ Students group that was taught using STAD model of cooperative learning had higher Mathematics Learning Achievement than the students group that had taught using problem based learning which correspond to the research work of Slavin, R.E. Medden, N.A. and Stevens, R.J. (1989: 22) that has studied the topic of Cooperative Learning Models for the 3 R'S that found that the cooperative learning model helps students to achieve higher than the normal learning classes.
- ✚ Students group that was taught using STAD model of cooperative learning had higher abilities in problem solving than the students group that had taught using problem based learning as according to Table No. 2 which corresponded to the research work of Ali Reza Jalilifar (2010) that studied the effect of cooperative learning techniques on college students' reading comprehension and found out that students reading comprehension efficiency has been increased by using STAD model of cooperative learning and their achievement level is high in reading English subjects.
- ✚ And there is significant effect of two teaching methods on problem solving ability and mathematics learning achievement.

## 7. Conclusion

This research revealed that STAD model of cooperative learning is useful in improving the students' mathematics learning achievement and problem solving ability. Moreover, it is evident that there is a difference in scores when compared to before and after the treatment (teaching methods- STAD model of cooperative learning and problem based learning. And in particular, among the experimental and control group, the experimental group secured high scores in mathematics learning achievement and problem solving ability. Hence it can be concluded that cooperative learning plays an important role in students' development.

## 8. Recommendations

From the results of the present study it is recommended that higher educational administrators should motivate lecturers to follow STAD model of Cooperative-Based Learning for teaching Mathematics. Thus the STAD Model of Cooperative-Based Learning is an interesting teaching technique. Hence the higher educational administrators, lecturers and researchers should experiment the process of STAD model of Cooperative-Based Learning continually for the application in other subjects too, which will develop students' ability.

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