

# The Study of Effectiveness of Cooperative Learning Approach in Teaching of Mathematics at Secondary Levels in Pakistan

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## Abstract

The literacy rate in any country is generally regarded as the index of development. If we examine the causes of low literacy rate and low standard of our education in Pakistan, one can find poor method of teaching as one of the major reasons. This is an age of science and technology, and as a matter of fact subject of mathematics serves as a foundation of many modern science and technology courses. In all of the academic disciplines, in one way or the other mathematics plays the fundamental role in learning and expanding the boundaries of existing knowledge. In this research paper we will examine the approach of corporate learning approach and how are teachers familiar to this new concept during teaching Mathematics at secondary level. Why student do not take interest in mathematics. For this purpose the population is comprised of all the registered students of 10th Class in the Government Girls (G.G. from now onward) High School Qasaban No.5 Dera Ismail Khan city. Fifty student from class 10 is selected randomly and divided into two groups namely Group A, and Group B. Data was analyzed through 1. Mean and standard deviation of scores obtained through pre-test of group A and B are calculated. 2. Mean, standard deviation and pooled standard deviation of scores obtained through post-test are calculated for both groups separately. 3. T-statistic and paired T are calculated. The first finding of the study is that the mean of pre-test mathematics achievement scores of group A and group B is the same i.e. 30.64 while there is variation in standard deviations are 7.12 and 5.79 respectively. The student learns through corporate learning techniques scored better than other. This may be attributed to students' dullness in learning math through traditional approach.

**Keywords;** Learning, Mathematics, Standard deviation, T statistics, Students,

## 1. INTRODUCTION

### 1.1 Background of the Study

With the evolution of human civilization mankind has demonstrated its ability to conquer and harness natural forces for its development and welfare. Twentieth century has witnessed large scale introduction of new scientific concepts and technology for molding economic, social and educational systems and transforming them in accordance with specific natural policies.

The literacy rate in any country is generally regarded as the index of development. If we examine the causes of low literacy rate and low standard of our education in Pakistan, one can find poor method of teaching as one of the major reasons. This is an age of science and technology, and as a matter of fact subject of mathematics serves as a foundation of many modern science and technology courses. In all of the academic disciplines, in one way or the other mathematics plays the fundamental role in learning and expanding the boundaries of existing knowledge. There is a general feeling that the standard of mathematics and science education is declining day-by-day. One of the indicators of poor standard of mathematics and science education is overall unsatisfactory results of these subjects in the public examinations.

It seems that we have not utilized modern technology and innovative methods of teaching mathematics to our students and still we are teaching mathematics through traditional methods although these are not much effective, while, the basic foundation of teaching is to prepare a student to make sound judgment and solve the problems of life through scientific methods. It also aims at helping student to become useful member of society, enabling him to make independent experiments for tackling day-to-day problems of his practical life.

In Pakistani schools traditional approach is used and considered useful but now there exists a feel that cooperative approach is essential for the development of teaching. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. The idea is simple, i.e. class members are organized into small groups after receiving instruction from the teacher. They then work through an assignment until all group members successfully understand and complete it. It has been noted

that in cooperative learning students' through good attainment perceive that they can reach their learning goals if and only if the other students in the learning group also reach their goals.

The study aims at finding out the effectiveness of 'cooperative learning approach' in teaching of mathematics at Secondary Level. More, the objectives of the study include: to find the effectiveness of two different teaching methods, i.e. traditional method and cooperative learning approach, to discover the most effective and valuable method of teaching mathematics at Secondary Level and to put forward some suggestions and recommendations in the light of findings and conclusions of this study.

### **1.1 Statement of Problems (SoP's)**

The study focused on answers to the following questions:

- 1 How far the teacher (s) involved in teaching of mathematics at secondary level is (are) familiar with the concept of 'cooperative learning approach'?
- 2 Did the teacher (s) involved in teaching of mathematics at secondary level try some other teaching method other than the traditional one and with what result?
- 3 What are the possible reasons that students in general do not take interest in learning mathematics specifically at secondary level?
- 4 Focused on finding whether the loss of interest is due to the curriculum or method of teaching.

## **2. REVIEW OF RELATED LITERATURE**

Mathematics has a long history as old as the first man on earth posed questions about the events happening in this universe such as "What is it? And why it is so?" Past illuminates the Present; and Present projects the Future". Hence, the wisdom resides partially in history, which must be reviewed in order to gain general knowledge.

Even before 3000 B.C. the peoples of ancient Babylonian, China and Egypt had developed practical systems of mathematics. They were using written symbols to represent numbers, and they performed simple arithmetic operations. This knowledge was useful to them in business transactions and government. They also developed and taught a practical geometry which then helped the students to move into the areas such as agriculture and engineering. The ancient Egyptians and the Greeks, between 600 and 300 B.C. became the first people to develop mathematics based on logical reasoning, and hence used points, lines, circles or other simple figures to explain the mathematical ideas. Greek mathematician recognized irrational numbers. Well-known Pythagorean Theorem was developed. Ptolemy (A.D. 150) developed Trigonometry and Diaphanous (A.D. 275) worked on numbers in equations and earned the title 'Father of Algebra'. Newton and Leibniz created 'Calculus'. Over the years, many great mathematical minds such as Abraham de Moivre, Euler, Laplace and Gauss contributed a lot to the development of mathematics. Certainly the advent of the electronic computer has increased our ability to analyze vast numerical data. While mathematical methods have long been an integral part of the study of engineering and other physical sciences, recognition of the teaching of mathematics in an effective manner is becoming more and more widespread.

In 1987 William Bennet, the Education Secretary of United States, while presenting Annual Report to the US President said in his report that Nation's youth is weak in mathematics. The US President took the finding so serious that he through an executive order made the teaching and learning of mathematics a mandatory for all students up-to the level of BS whatsoever their major is.

It is common observation that our young students right from their start of education are either afraid of learning basic mathematics or they consider the subject difficult or boring. This psychological impact moves along with them and grows stronger and stronger as they proceed towards secondary education or beyond. This may be the one side of the story. The other side relates to what we call pedagogical, and this demands from teachers to come forward and play their role not only help remove the prevailing psychological impact but to present and teach the subject of mathematics in such a manner that motivates the young students to learn more and more about mathematics considering it as an important tool for the progress of their future academic achievement. Best academic achievement, in turn, brings prosperity in one's life which entails enhancement in development process and service to the community.

In Pakistan, generally we use the traditional methods in teaching which we cannot discard with one stroke of pen since those worked in the past and still work. But in this era of computer and information technology, the need has arisen to modify our classical methods of teaching of various subjects, specifically related to computer and information technology which heavily hinge upon mathematics.

How to make students a part of learning process (especially focusing on mathematics)? One of the ideas is to try 'cooperative learning' which is the instructional use of small groups so that students work together to maximize their own and each others' learning, the idea is simple but important.

In cooperative learning students of the class are divided into two groups of their own choice and each group is expected cooperate with one another in the learning process. It is assumed that in situations of cooperative

learning student's good accomplishment compel the students to perceive that they can get their learning goals if and only if the other students in the learning group also achieve their goals.

### **2.1 Existing Research**

Teaching is the oldest activity that could be found in all societies during all historical periods. Different scholars have defined it differently such as "teaching is an intimate contact between a more mature personality and a less mature personality which is designed to further enhance the knowledge of latter (Morison, H.C., 1960)," while according to the Dictionary of Education "teaching is a work of occupation of teachers". Likewise Smith (1962) defines teaching as imparting knowledge of an individual to another in a school.

### **2.2 Significance of Mathematics**

In early days when men lived in caves he did not need arithmetic. His immediate concern was only the welfare of his children. His need apart from food and shelter, were very few but when the men began to live in communities, he wanted better thing for himself and his family. With developing civilization he found it necessary to calculate. The main purpose of teaching mathematics is to help the students in developing their abilities to solve problems of daily life now and in the future. Mathematics provides skills, logic, processes and special kind of language which enable students to sharpen their thinking power. Good teaching can be achieved through a proper balance between the social and mathematical aspect of arithmetic.

In the present world of science and technology it is impossible to do without mathematics. One of the early scholars Beacon says "mathematics is the gateway and key of all sciences." This points that all scientific education which does not commence with mathematics is defective at its very foundation, where as according to Kant, "mathematics serves as the basis of judging one's mental capacity". Napoleon once said, "The progress and improvement of mathematics are linked with the property of state."

Mathematics has played a major role in human civilization by means of measuring property, boundaries, ships, building homes etc. Many mathematical concepts are used in daily life in exploring resources while dealing with business — in calculating our gains and losses.

Newspapers and official statements are full of numerical data, tables and graphs portraying people's trend. An educated researcher must be able to interpret the data with understanding and to benefit it wisely. The future progress of man rests upon his ability to apply the achievement of science and technology. This being the important aspect of our life requires that our youth may thoroughly be schooled in principles of science, so that they may properly understand and contribute to this progress. In the coming times a leading role will be played by our teachers of science and mathematics. To achieve the desired goals, the mathematics teachers should have a clear understanding of the basis of for this profession and must enjoy the command over the facts of science. They should have the ability to encourage and inspire the students who study under his/her supervision.

### **2.3 Mathematics in Schools Curriculum**

Every body needs some knowledge of mathematics in one or the other way to deal with daily life matters. It is felt that for an ordinary man, the knowledge acquired during primary and secondary stage of education will satisfy his future needs. Consequently, there is a great deal of controversy over making mathematics elective or compulsory at the high school level. Besides, the subject of mathematics is generally perceived as a difficult subject with a view that its study requires special ability and intelligence. Therefore, everybody should not be burdened with the study of this subject. In support of this argument references are made to low pass percentage in this subject. Despite all these no one can deny that mathematics is very useful subject for most vocational and highly specialized courses of learning.

Everybody, who is studying it in the school, is not going to be an accountant, an engineer or a statistician. But at an early stage of education it is difficult to know and predict accurately who is going to be an engineer or a banker. Therefore, the purpose of study at school level is given to high school level students to embark a new voyage of what he is capable of achieving in future. At university level, most of the physical and social sciences requires the application of mathematics. No other subject can be considered as a substitute for mathematics. However, while making mathematics a compulsory subject, the interest of both of both type of students will have to be safeguarded — the syllabus must contain such subject matter that are useful for those who wish to discontinue their education after high school stages and are entering into a profession and for those who wish to continue their education beyond high school stages.

### **2.4 Need of Right Method of Teaching Mathematics**

Researches have proved that the best of curriculum and the most perfect syllabus remain to deal with unless supported by the right method of teaching. A method is the basis of reaching predetermined ends if in fact it forms the most important link in the total teaching learning chain which has, on the one hand, the goals and the purpose and on the other hand results and values. We can understand the importance of a teaching method from this saying of Quaid-e-Azam, "there is no doubt that the future of our state will and must greatly depend upon the type of education, we give to our children and the way in which we bring them up as future citizens of

Pakistan.” This is a fact that desirable results can only be achieved if and only if correct method is adopted and that’s what our objective of search is.

#### **2.4.1 Traditional Method**

In this study we take the traditional method as a method of teaching in mathematics as to solve either theoretical or numerical problems on the blackboard. No discussion of teaching method can ignore the lecture method which appeals to every one — a prototype thinking reflecting what is meant by a teaching through traditional method. A summary of the properties/characteristics of traditional method of teaching mathematics is given below:

1. A teacher solves all the theoretical or numerical problems on the blackboard.
2. Students’ learning moves by copying the solved problems from the blackboard.
3. If any student faces some difficulty in resolving a problem he/she can check the solution of the problem from his/her class notebook.
4. Students do less work at home and little is left for them to think about the solution.

#### **2.5 Cooperative Teaching Method**

In this method a class is divided into small groups. Each group is given a task which the group accomplishes by cooperation. The value of cooperative learning has been recognized throughout human history. Organizing individuals to work in support of one another and putting the interests of group ahead of one's own are abilities that have characterized some of the most successful people of our time. Group learning, with its roots in ancient tribal customs, has traditionally been a part of educational practice. Its effectiveness has been documented through hundreds of research studies, for example, one can see the work of Johnson & Johnson (1986) and Slavin (1988).

Cooperative learning is now widely recognized as one of the most promising practices in the field of education. During much of its history, however, cooperative learning methodology was developed in settings where few, if any, of the students came from non-English language backgrounds. When many of the originators of cooperative learning emphasized the importance of heterogeneity in forming groups, it is doubtful that they envisioned a classroom where non-English speakers and native English speakers were members of the same group. Yet, such a classroom is becoming the rule rather than the exception as pointed out by Olsen & Chen (1988).

Cultural and linguistic diversity in the students’ population has profound implication for education. The learning climate of the classroom is affected by the nature of interactions among students. In a culturally diverse classroom, students reflect a variety of attitudes towards expectations of one another's abilities and styles of behaviors. Without structures that promote positive interactions and strategies for improving relationships, students remain, detached from one another, unable to benefit from the resources their peers represent. Teachers and students need strategies that manage cultural and linguistic diversity in positive ways, strategies that channel peer influence into a positive force for improving school performance. Further, to reach students from diverse cultural backgrounds teachers need multiple alternatives to prevalent pattern where teachers do most of the talking and directing in the classroom (see for example, McGroarty, in press).

#### **2.6.1 Cooperative Learning for Culturally & Linguistically Diversified Students**

The potential of cooperative learning techniques for helping educators lies in the fact that the approach helps them to transform diversity into a vital resource for promoting secondary students’ acquisition of challenging academic subjects. Assumptions underlying cooperative learning for secondary English language learners are briefly described, as well as what we know about how the cooperative learning can be used to maximize the acquisition of a second language, of content, and of the development of interpersonal skills. Examples of cooperative structures and activities for students at the secondary level are presented, and a sample world history unit for Grade 10 is provided. Cooperative learning has become popular for many reasons. Some of these are listed below:

1. It adds variety to the teacher's repertoire.
2. It helps teachers manage large classes of students with diverse needs.
3. It improves academic achievement and social development.
4. It prepares students for increasingly interactive workplaces.
5. One of its most powerful, long lasting effects may be in making school a more humane place by giving students a stable, supportive environment for learning.

This is hoped that increasing number of students will experience the personal and academic growth that come through learning, persevering and maturing with others.

#### **2.6.2 Cooperative Learning & Effective Instructional Practices**

The phrase "students from diverse language backgrounds” refers to three categories of students. One group is English-only (EO), i.e. they are students who have learned English as their primary language. Another group consists of English language learners (ELL), i.e. these students have a primary language other than English and

are currently engaged in learning English. A third group is English proficient (EP), i.e. these students have a primary language other than English but are proficient in English.

When students from these categories are placed in the same secondary classroom, their linguistic and cultural diversity creates tremendous challenges for teachers. Effective responses to this diversity include strategies that link the students in mutually supportive ways and provide them with multiple, varied, and equal opportunities to acquire content and language. Learning cooperatively in teams where 'all work for one' and 'one works for all' gives students the emotional and academic support that helps them to persevere against the many obstacles they face in school. Not only do cooperative teams give students additional motivations to stay in school and improve academically but also help them learn the skills that they will need for the increasingly interactive workplaces of the future.

This suggests many different ways to use cooperative teams in order to accelerate the learning of students from diverse language backgrounds. Teachers will find activities that can be used during a five-minute, fifty-minute, or five-week period of time. Students will benefit from participation in both short-term and long-term experience in cooperative teams. However, being a member of a team that stays together over an extended period of time may provide students some of the greatest potential for language, academic and social growth. For example, a cooperative team may stay intact for an entire academic year or even several successive years. D.W. Johnson has pointed out many benefits of long-term participation in base groups. For more on the use of base groups in cooperative learning, see Johnson and Holubec (1988). Perhaps the optimal cooperative environment is created by teachers who use a variety of teams for various purposes. For example, a student might be a member of several teams; one of short-term, intermittent purposes, such as planning an outing for the class; another for specific content areas like those in the sample unit in this guide; and still another as a home team or 'base group' that meets on a regular basis to deal with members' personal and academic needs (Johnson & Holubec, 1988). In order to add stability and support to the students' school experience, the membership of the base group would remain constant for a semester, a year, or as long as is practical.

Long-term and consistent participation in the same team ensures that individual students have peers who are concerned about their success in school. Sustained work in heterogeneous, cooperative teams helps students acquire the skills necessary for working effectively with people of different ethnic, racial, and linguistic backgrounds. When conflict arises among team members, students need to learn how to resolve it and grow from it, rather than trying to move to another team, get rid of the 'problem' member, or pretend that the conflict is not there. Participation in a home team or base group enables secondary school students to view conflict as a positive force, moving the team members to a higher level of individual maturity and group cohesion.

### **2.6.3 Cooperative Learning in the Secondary School: Meeting the Students' Needs**

Secondary English Language Learners (ELL: Grades 7-12), especially recent immigrants, face major difficulties in acquiring English. They arrive in the United States at eleven to eighteen years of age with different levels of literacy, education, and language proficiency. The following is a description of some of the differences among ELL students and between ELL students and their native English-speaking peers.

Compared with elementary students, secondary ELL students have fewer years to acquire the English language essential to success in their required subjects. The demands of the curriculum and the short time available for learning English put secondary ELL students significantly behind their native English-speaking peers in academic achievement [Collier (1987), Minicucci & Olsen (1992)]. Recent statistics show that each middle school is the beginning of a high rate of dropouts [Minicucci (1985), Olsen & Chen (1988)]. Despite these obstacles, research tells us that secondary students do have some advantages in acquiring English. Cummins (1981) states: "Older learners who are more cognitively mature and whose L1 (native language) proficiency is better developed would acquire cognitively demanding aspects of L2 (second language) proficiency more rapidly than younger learners. The only area where research suggests older learners may not have an advantage is pronunciation, which, significantly, appears to be one of the least cognitively demanding aspects of both L1 and L2 proficiency".

Many secondary students arrive better able to comprehend and speak English than read and write it. Others may be able to understand the written word but have little or no ability to comprehend oral English. Finally, secondary students enter U.S. schools with varying levels of education in their native language. Some arrive with no prior education; others arrive with levels of education equal or superior to those of native English speakers. Research shows that students with strong academic and linguistic skills in their first or native language will acquire a second language more easily than those with weaker skills [Cummins, (1981)]. Cooperative Learning in the Secondary School has the following properties:

- Students learn easily due to the small in numbers.
- Students can discuss any problem in the group.
- More problems can be solved in a less time.
- Teacher can check their home work regularly and can teach in the same time period.

- Students are active because teacher can ask any question to them.

#### **2.6.4 Monitoring & Evaluation in Cooperative Learning**

Effective implementation of Co-Op CO-Op and other cooperative learning methods depends on the teacher's carefully supporting students and giving them feedback on their progress in meeting academic, language, and social objectives. Compared to other cooperative structure, in Co-Op Co-Op the students are given great deal of responsibility for their learning; they choose their topics of study and the method of presenting their research and give feedback to their peers.

The teacher needs to establish and reinforce cooperative norms so that students know that it is all right to help each other. They need to know when they are supposed to work along or be in their groups. They also need to know what they are expected to produce and how they will be evaluated. In order to accomplish these ends, team building activities should be incorporated regularly into the lessons. In Co-Op Co-Op students should receive positive, supportive feedback from the teacher as well as their peers. Peer feedback focuses on learning outcomes or one what students did to help each other learn about colonialism.

#### **2.7.1 Steps in Co-Op Co-Op**

An overview of the steps to Co-Op Co-Op is provided below. A more detailed description of the rationale and steps to Co-Op Co-Op can be found in Kagan (1990). The Co-Op Co-Op structure and the phases used to organize this unit are related to Group Investigation — a cooperative learning method developed by Sharan and Sharan (see Sharan et al 1980). Co-Op Co-Op consists of ten steps.

- A whole-class discussion dealing with students' interests and needs relative to the lesson topic.
- The formation of heterogeneous teams (teacher- assigned or student-selected).
- Team building and cooperative skill development.
- The selection of each team's topic;
- The selection of mini-topics by individual team members;
- Mini-topic research and preparation of mini-topic presentations to fellow team members;
- The presentation of mini-topics;
- Te preparation of team presentation to the whole class;
- Team presentations to the whole class; and finally
- Feedback to teams and individual learning members.

### **3. METHODOLOGY OF THE STUDY**

#### **3.1 Approach: The Experimental Design**

One 10<sup>th</sup> class was randomly assigned to experimental treatment and control group without disturbing the class structure. The results of pre-test further helped to check equivalence of mathematics achievement of two groups. Here class is divided into two groups, each group comprises of 25 students. Group 'B' was taught by traditional method and group "A" was taught by cooperative method of teaching mathematics. Study continues for 15 days with 40 minutes of each group every day. During this period 10 lessons are delivered to each group. The researcher herself taught all lessons to both the groups, and at the end of every week, a separate post-test is administrated to both the groups to determine the effects of two different teaching methods. Tests were marked and thus data are obtained, arranged in tabulated form and analyzed. On the basis of analysis of the data, finding, conclusion and recommendation are made.

#### **3.2 Population**

In this study, the population is comprised of all the registered students of 10<sup>th</sup> Class in the Government Girls (G.G. from now onward) High School Qasaban No.5 Dera Ismail Khan city.

#### **3.3 Sample & Sampling Procedure**

The random sample contains 50 students of 10<sup>th</sup> Class of G.G. High School Qasaban No.5 Dera Ismail Khan city.

#### **3.4 Instruments**

The following instruments were utilized for the experiment:

1. Teacher made achievement test comprising of objective type questions used as pre-test for dividing the sample into two groups.
2. Teacher-made post-test used for finding out the effects of each method used on academic achievement of the students.
3. Ten lesson plans for teaching through traditional method.
4. Ten lesson plans for teaching through cooperative method.
5. Activities performed for teaching mathematics through traditional method and cooperative learning approaches.
6. Contents or subject matter of mathematics for the class selected from first 5 exercises.

### 3.5 Data Collection Procedure

First of all the students of 10<sup>th</sup> class were divided into two groups designated as Group A and Group B. Every effort is made to equalize the two groups on the basis of age, socio-economic background of family and the achievement in the pre-test. Then group A was taught with the help of cooperative method and this group was called experimental group. The group B was taught through traditional method and this group was called controlled group. The cooperative method was planned in such a manner that students should derive a mathematical concept or a principle and then solve the problems through cooperation within the group.

### 3.6 Statistical Analysis

The following statistical methods are applied for the analysis of data:

1. Mean and standard deviation of scores obtained through pre-test of group A and B are calculated.
2. Mean, standard deviation and pooled standard deviation of scores obtained through post-test are calculated for both groups separately.
3. T-statistic and paired T are calculated.
4. To reach at conclusions computed values of T and Paired T are compared with critical values at 5% level of significance.

### 3.7 Major Variables

The academics achievement of students was the dependent variables of this study, while Methods of teaching i.e. Traditional method of teaching versus cooperative learning method. Similarly the Controlled variables of the study include the teacher, subject matter, classroom condition and time, where the uncontrolled variables are the student's age, I.Q. of the students, socio-economics level of parents and the study behavior.

### 3.7 Hypothesis/Claims of the Study

Following hypotheses were developed and tested in this study:

1. There is no significance difference in the achievement of students taught mathematics through Traditional (T) approach and through Cooperative Learning (CL) approach. In symbolic terms:

$$H_0: \mu_{CLA} = \mu_{TB} \quad \text{versus} \quad H_1: \mu_{CLA} \neq \mu_{TB}$$

Where  $\mu_{CLA}$  and  $\mu_{TB}$  denote the achievement (in terms of average) of students taught through cooperative learning (Group A) and traditional (Group B) approaches respectively.

2. There is no significance difference in the achievement of students first taught mathematics through traditional approach and then taught through cooperative learning approach. In symbolic terms:

$$H_0: \mu_d = 0 \quad \text{versus} \quad H_1: \mu_d \neq 0$$

Where  $\mu_d$  denote the mean of differences in pre-test and post-test scores of students taught through cooperative learning approach.

## 4. PRESENTATION & ANALYSIS OF DATA

This chapter deals with presentation and analysis of data collected during the study. Tables A1 to A5 are placed in Appendix A wherein Table A1 presents the list of students included in the sample and Tables A2 and A3 show the pre-test mathematics achievement scores of experimented group "A" and control group "B" respectively. Similarly, in Appendix A, Tables A4 and A5 present the post-test mathematics achievement scores of experimented group "A" and control group "B" respectively. Statistical Analysis has been carried out in Appendix B. The tables given below reveal the results of analysis.

Table 4.1 The mean and standard deviation of pre-test scores of experimental group 'A' and control group 'B'

Group	Sub-sample Size	Mean	Standard Deviation
A	$n_1 = 25$	30.64	7.12
B	$n_2 = 25$	30.64	5.79

We note that mean score of both group is same while scores of group A are more dispersed around the mean as compared with group B.

Table 4.2 The mean and standard deviation of post-test scores of experimental group 'A' and control group 'B'

Group	Sub-sample Size	Mean	Standard Deviation
A	$n_1 = 25$	39.60	3.83
B	$n_2 = 25$	28.64	6.56

The 25 students of group A were taught by the cooperative method whereas the other 25 students of group B were taught by the traditional method. Comparing these summary measures we notice that performance of group A is much better than the group B both in terms of average and dispersion. Better performance of group A may be attributed to the use of cooperative method.

### 4.1 Tests of Hypotheses

For t-test, the following table present summary of the calculations involved. Detail calculations are given in Appendix B.

Table 4.3 Calculated value of T of post-test scores of group ‘A’ and group ‘B’

Group	Sub-sample Size	Difference of means $\bar{X}_1 - \bar{X}_2$	Pooled-standard deviation $s_p$	Calculated value of T	Tabulated value of T at $\alpha = 5\%$
A	$n_1 = 25$	10.96	5.37	7.21	$T_{(0.025, 48)} = 2.01$
B	$n_2 = 25$				

P-value < 0.025

The above table now leads us to test our first hypothesis: From the Results it can be inferred that there is no significance difference in students’ mathematics scores taught through Cooperative Learning(CL) approach (group A) and through Traditional(T) approach(group B). In symbolic terms the above hypothesis can be stated as:

$$H_0: \mu_{CLA} = \mu_{TB} \text{ versus } H_1: \mu_{CLA} \neq \mu_{TB}$$

Where  $\mu_{CLA}$  and  $\mu_{TB}$  denote the mathematics achievement (in terms of average) of students of groups A and B who were taught math through cooperative learning and through traditional approaches respectively, the critical region is:

$$\text{Reject } H_0 \text{ if } T_{\text{calculated}} > |2.01|$$

Since calculated value is greater than the tabulated value, hence at 5% level of significance we reject the null hypothesis and conclude that there is a significant difference in the scores achieved by students taught through traditional approach and through cooperative learning approach.

For paired T-test, the following table present summary of the calculations involved. Detail calculations are given in Appendix B.

Table 4.4 Calculated value of Paired T-test Based on Pre-test and Post-test Math Scores of Group ‘A’

Group	Size	Calculated value of Paired T	Tabulated value of T at $\alpha = 5\%$
A	25	$T = -2.90$	$T_{(0.025, 24)} = 2.064$

The above table now leads us to test our second hypothesis that “there is no significance difference in the achievement of students first taught mathematics through traditional approach and then through cooperative learning approach. In symbolic terms:

$$H_0: \mu_d = 0 \text{ versus } H_1: \mu_d \neq 0$$

Where  $\mu_d$  denote the mean of differences in pre-test and post-test math scores of students taught first through traditional and then cooperative learning approaches. The critical region is:

$$\text{Reject } H_0 \text{ if } T_{\text{calculated}} > 2.064 \text{ or } T_{\text{calculated}} < -2.064$$

Since calculated value is less than the tabulated value so Group A’s pre-test and post-test math scores differ significantly because of two different methods of teaching.

## 5. FINDINGS, CONCLUSION & RECOMMENDATIONS

### 5.1 Major Findings

The first finding of the study is that the mean of pre-test mathematics achievement scores of group A and group B is the same i.e. 30.64 while standard deviations are 7.12 and 5.79 respectively. The equality of means of two groups shows that the groups A and B are similar in mathematics achievement in the beginning of the study. However, the standard deviations of both groups differ. For group B we notice less variation in scores as compared to scores obtained by the students of group A.

The second finding is that the averages of scores of group A and group B in math are 39.6 and 28.64 respectively on post-test administrated after a week. Besides, the students of group A learning math through cooperative approach have sustained greater average than group B in the subsequent managed tests. This reflects a statistically significant difference between the means of two groups. This aspect is further tested through the tests of hypotheses.

The third finding is that comparing the means of mathematics achievement scores of group 'B' on pre-test and post-test we notice average of post-test decreased rather than increased. This may be attributed to students’ dullness in learning math trough traditional approach.

The fourth finding is that to test the hypothesis of no significant difference between two methods of teaching, T-statistic is calculated which is 7.21 while critical value of T at 5% level of significance for 48 degrees of freedom is 2.01. This has lead to reject the hypothesis of no significant difference, and we conclude that both methods differ significantly.



To see the effects of cooperative approach, we test the hypothesis of no significant difference between the pre-test scores and post-test scores of group A. For this testing we need to apply paired T-test. The calculated value of paired T is found as  $-2.90$  while critical value of T at 5% level of significance for 24 degrees of freedom is  $|2.064|$ . This has led to reject the hypothesis of no significant difference, and we conclude that cooperative is very much effective in teaching math.

### **5.2 Conclusion**

The new age is the age of science, computer and information technology. Hence without improving and modernizing our method of teaching, we cannot develop our education of technology and science. Also, we cannot keep pace with the changing circumstances and need of the hour. This study is significant because of the following points. To study the most effective teaching in mathematics at Secondary Level, new approaches should be used in teaching of mathematics at the same level and for getting the good results of mathematics at the same level thereby making the students to be more practical in their lives.

It is our common observation that our young students right from their start of education are either afraid of learning basic mathematics or they consider the subject difficult or boring. This psychological impact moves along with them and grows stronger and stronger as they proceed towards secondary education or beyond. This may be the one side of the story. The other side relates to what we call pedagogical, and this demands from teachers to come forward and play their role not only help remove the prevailing psychological impact but to present and teach the subject of mathematics in such a manner that motivates the young students to learn more and more about mathematics considering it as an important tool for the progress of their future academic achievement. Best academic achievement, in turn, brings prosperity in one's life which entails enhancement in development process and service to the community.

Scholars in the field of education are aware of their prime duty and thus remain engaged in devising methods of teaching through extensive research in order to achieve best possible results.

In our country, generally we use the traditional methods in teaching which we cannot discard with one stroke of pen since those worked in the past and still work. But in this era of computer and information technology, the need has arisen to modify our classical methods of teaching of various subjects, specifically related to computer and information technology which heavily hinge upon mathematics.

How to make students a part of learning process (especially focusing on mathematics)? One of the ideas is to try 'cooperative learning' which is the instructional use of small groups so that students work together to maximize their own and each others' learning. The idea is simple but important. Class members are organized into small groups after receiving instructions from their teacher.

Then they work through the assignment until all group members successfully understand and complete it. It is assumed that in situations of cooperative learning students' good accomplishment compel the students to perceive that they can get their learning goals if and only if the other students in the learning group also achieve their goals. In cooperative learning students of the class are divided into two groups of their own choice and each group is expected cooperate with one another in the learning process.

### **5.3 Recommendations**

1. Students should be taught mathematics through cooperative method at the level of grade 10<sup>th</sup>.
2. Teachers must convince students of secondary classes to learn through cooperative method.
3. If we still insist to use traditional method, then it must be improved according to the recommendations of the researchers.
4. Cooperative method is an easy method. It should be used regularly at this level so that students' future life both in practice and in academics is made more productive and effective.

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