



## COOPERATIVE LEARNING: AN APPROACH FOR TEACHING MATHEMATICS IN PUBLIC SCHOOL

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### Abstract:

This paper presents a definition, the history, types, principles, a review of related literature, and application of cooperative learning. Cooperative learning is another method of teaching and learning that involves the students of different stages of willingness work cooperatively towards a common objective. The literature revealed positive effects of cooperative learning on students, especially in the areas of achievement and attitudes toward learning of mathematics content. The schools that have applied cooperative learning have found it to be a very effective teaching and learning method.

**Keywords:** cooperative learning, mathematics, achievement, attitudes toward mathematics

### 1. Introduction

Mathematics plays a vital role in developing problem-solving, reasoning power and critical thinking which promotes logical understanding among students. It is a major subject critical to understanding other major fields. Out of many secondary mathematics topics, Algebra, Simultaneous equations, Indices and Logarithms were considered to be most importance because their utility and are the foundation in the school curriculum (Ministry of Education, 2018). However, today the teaching and learning of the topics are in a miserable condition. This perennial problem may be precipitated by the teaching technique in which the teachers still maintain the

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traditional method despite the emergence of new teaching methods, strategies, techniques, and approaches. So with improved methods of teaching the old practice is detrimental to the comprehension of the subject. Many research studies have been conducted and conclusions have shown that cooperative learning strategy is a helpful instructional strategy which promotes students' learning achievement (Johnson & Johnson, 1989; Slavin & Farnish 1991; Maden 2011; Van Dat, 2016).

Cooperative Learning refers to as an educational strategy where students of different levels of readiness work cooperatively towards a common goal. Cooperative learning is an instructional method that makes students learn and work together in small group on academic task. It entails grouping students into small, mixed ability learning groups. It is premised on the fact that students work together cooperatively and interdependently in small groups towards a group goal (Wendy, 2005).

### 1.1 Historical Background of Cooperative Learning

Allport, et al (1954) postulated a theory on learning method which promoted a team work. According to them, team work promotes productivity with regard to quantity and quality as opposed to working alone. Similarly, (May & Doob, 1937) established that people who unite and work as a team achieve the desired objectives and are more successful in achieving results than people who work alone. They also discovered that a person who works alone has a probability of displaying competitive behaviors.

**Table 2.1:** Time-Line of Historical Background of Cooperative Learning

Date	Event
Early 1900s	John Dewey, Kurt Lewin, Jean Piaget, Lev Vygotsky.
1960s	Stuart Cook: Research on Cooperation Madsen (Kagan): Research on Cooperation & Competition in Children. Bruner, Such man: Inquiry (Discovery) Learning Movement B.F. Skinner: Programmed Learning, Behavior Modification
1962	Morton Deutsch: Cooperation & Trust, Conflict Robert Blake & Jane Mouton: Research on Intergroup Competition.
1966	David Johnson: Begins training teachers in Cooperative Learning
1969	Roger Johnson: Joins David
1970	David Johnson: Social Psychology of Education
1973	David Devries & Keith Edward: Combined Instructional Games Approach with Intergroup Competition, Teams-Games-Tournament.
1975	David & Roger Johnson: Research Review on Cooperation/Competition David & Roger Johnson: Learning Together and Alone
Mid 1970s	Annual Symposium at APA (David DeVries & Keith Edwards, David & Roger Johnson, Stuart Cook, Elliot Aronson, Elizabeth Cohen, others) Robert Slavin: Began Development of Cooperative Curricula Spencer Kagan: Continued Research on Cooperation Among Children
1976	Shlomo & Yael Sharan: Small Group Teaching (Group Investigation)
1978	Elliot Aronson: Jigsaw Classroom, (Journal of Research & Development in Education, Cooperation Issue) Jeanne Gibbs: Tribes
1981-1983	David & Roger Johnson: Meta-Analyses of Research on Cooperation
1985	Elizabeth Cohen: Designing Group work Spencer Kagan: Developed Structures Approach to Cooperative Learning

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1989	David & Roger Johnson: Cooperation & Competition – Theory & Research
Early 1990s	Cooperative Learning Gains Popularity among Educators
1996	First Annual Cooperative Learning Leadership Conference, Minneapolis

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Adopted from: <http://fp.uni.edu/rac/col/3-timeline.htm>

Dewey (1916) argues that it is essential for students to develop knowledge and social skills that could be used outside the classroom and in the democratic society. This theory views student as active recipients of knowledge in a learning process who deliberating engage in groups, interacting among themselves rather than the teacher is dominating the class room and the students listening. In 1994, Johnson and Johnson used Dewey's theory of learning in which they used five rudiments of Cooperative Learning which are positive interdependence, individual accountability, face-to-face interaction, social skills, and processing.

## 2. Cooperative Learning

This is an instructional approach that organizes class activities into academic and social learning experiences. The theory postulates that students work as a team in order to accomplish academic tasks and objectives. Temesgen & Enunuwe (2014) states that Cooperative Learning entails mixed levels of ability which are arranged into groups and rewarded according to the group's success, rather than the success of an individual member. Similarly, Slavin (1996) sees cooperative learning as student-centered which means students are responsible for their team learning. In a related vein, (Slavin 1996) sees cooperative learning as an educational method of grouping students into small teams so as to work collectively and achieve the desired goals. Cooperative Learning therefore, involves learning that takes place in a classroom where students share ideas aiming at completing a given task. In the same manner, Jebson, (2012) defines cooperative learning as an educational approach in which students work cooperatively towards attaining common objectives.

Cooperative Learning is a practical learning strategy which makes the students proactive in their learning. In other words, it is inclined to a social environment (Vanwyk, 2010). Moreover, Adams & Hamm (1996) define cooperative learning as a social instructional strategy of small teams with students of different level of academic ability. From this inference, cooperative learning is an instructional design that teaches learners together in a small group to interact actively on certain issues required of them under the watch of the teacher (Johnson 1993; Slavin 1996; Farzad 2015). Furthermore, both Vanwyk (2010) & Adam (1996) see that cooperative learning as an instructional strategy where students come together and work as a team to accomplish a desire objective. In a similar vein Slavin (1990) Says cooperative learning refers to as research approach to pedagogy in mathematics. Students work collectively and help each other. Studies revealed that learning mathematics in a team has found strong positive effect when goals are incorporated with individual accountability (Slavin, Sheard, Elliot, Chambers, & Cheung, 2013).

## **2.1 Principles of Cooperative Learning**

There are five basic principles of cooperative learning that should be adhered to by the students which are as follows:

### **A. Positive Interdependence**

Positive interdependence can occur if students in a group believe that they are part of an unbreakable bond in pursuit of success (that is they must believe that they sink or swim together). The members of a group need to work together and assist each other in order to complete a given academic task. Each member of a group is responsible to learn the learning material as well. Members perceive that they are linked in such a way that one cannot succeed unless every one succeeds (Johnson & Johnson, 1994). That is each individual depends on the other members of the group. In this situation teacher needs to provide rewards for a successful group.

### **B. Individual Accountability**

After each individual's work is assessed and the feedback is immediately known to the group, then members of the group would know if any of them requires assistance in completing the task. Each member is accountable for their own learning as well as that of their group members.

### **C. Face to Face Interaction**

The face to face interaction is another principle cooperative learning that would enable group members to learn better. Students sitting close and facing each other, help in the sharing of ideas or answers. The teacher needs to promote each student to be successful by helping out, guiding and giving support, encouraging and praising them in learning.

### **D. Interpersonal and Small Group Skills**

Whenever one works in a group, social skills are needed. Student needs to be taught the social skills so as to achieve a higher quality of cooperation. These skills include the ability to instruct others to work together in a group and the ability to speak in a firm but soft voice and manage conflicts.

### **E. Group Processing**

Group processing is an evaluation step for group to discuss their performance. At the end of the group work, students gather and discuss how well students are achieving their goals and maintaining effective working relationships.

## **2.2 Types of Cooperative Learning Strategies**

There are several types of cooperative learning strategies. These include Students Teams – Achievement Division (STAD), Team-Games-Tournaments (TGT), Jigsaw Method, Team Accelerated Instruction (TAI), Group Investigation (GI), Team Assisted Individualization (TAI), Cooperative Learning and Teaching Scripts (CLTS), Cooperative Integrated Reading and Composition (CIRC), Cooperative Learning Structures, and Complex Instruction (Maddinabeita, 2006).

### **2.2.1 Student Teams Achievement Division (STAD)**

It is a strategy in which small groups of learners with different levels of ability come together and work on a given task to achieve a desired learning goal. It is one of the most

widely studied methods of cooperative learning (Slavin, 1990). It can be applied in many disciplines.

### **2.2.2 Group-Maths-Tournament (GMT)/ Team- Group- Tournament (TGT)**

The GMT method is a modified version of the TGT method developed by Robert Slavin. Team- Group- Tournament (TGT) uses the same presentations as in STAD, but replaces the test with weekly tournament game which does not use the system of improvement score. It can be used to teach mathematical skills and knowledge.

### **2.2.3 JIGSAW**

The Jigsaw strategy was developed by Elliot Aronson and Associates in the early 1970s. In their approach, the teacher presents a topic and its sub-topics while students are divided into small groups of five to six, which is referred to as Jigsaw groups. In Jigsaw application, the concept of learning is sub-divided into different segments, and each student is assigned to a sub-topic so as to enable him/her specialize. This means all students with similar topic form expert groups. This group of students reconvenes as soon as learning is over, in order to solve self-assessment questions individually. The achievement scores of individual members are added up to give the group aggregate scores

### **2.2.4 Team Assisted Individualization (TAI)**

The TAI method is designed for the learning of mathematics in small heterogeneous groups (2–4 students) per group. Each student is given a worksheet to be completed. Students would then work in pairs to check each other's worksheet. Students who obtain 80% and above from the worksheet, would be allowed to sit for the final test.

### **2.2.5 Learning Together (LT)**

David Johnson and Roger Johnson developed the Learning Together models. In this models, students would work on the task in 4-6 members heterogeneous groups. Worksheets would then be distributed to each group and required to submit the completed worksheet, for recognition. This would be based on the group's achievement.

### **2.2.6 Group Investigation (GI)**

The Group Investigation method also involves small groups of 2-6 students where each group would carry out the cooperative inquiry, discussion, and project. Moreover, it is said to be one of the most student-centered methods as students has much freedom to choose their topics of interest for investigation, plan and carry it out, present and evaluate the results.

## **2.3 Review of Related Literature on Cooperative Learning Effectiveness**

Cooperative learning has been a preferred alternative to conventional teaching for recent decades. Several research studies have examined the effects of cooperative learning on student's achievement and are found effective.

Aziz & Hossain (2010). A comparison of cooperative learning and conventional teaching on students' achievement in secondary mathematics. The results showed that there was a statistically significant difference in favor of the experimental group.

Sherman & Thomas (1986) compare the effects of Cooperative Learning on all levels of students: bright, average, and weak, to see if Cooperative Learning could enhance achievement in mathematics for students. The results of the study indicated that students at all levels were found to retain memory much longer, increase the ability to solve mathematics problem, and develop positive attitude towards learning mathematics and have a higher self-esteem. Furthermore, Leikin, & Zaslavsky (2013) studied Cooperative Learning in mathematics and they concluded that the experimental group in Cooperative Learning setting enabled a higher level of learning. Equally important was the study conducted by Ajaja & Eravwoke (2010). The study used 2x2x2x2 factorial, Pre-test, Post-test Control Group design which included two groups of males and females; high and low. The recurrent test indicated that learners taught under Cooperative Learning approach earned higher scores in science achievement test than those taught under traditional method of teaching. Again, Zita (2010) conducted a research on seventy-two students from four College mathematics classes. The study used a mixed methodology (Quantitative and Qualitative) design. The research showed an improvement in mathematics achievement. Additionally, Kolawole (2008) studied Comparing Cooperative Learning Strategy and Competitive Learning Strategy in teaching of mathematics at Secondary School level using a sample of 400 learners out of which 240 were boys and 160 girls. The result revealed that Cooperative Learning is more effective than competitive learning method in teaching and learning of mathematics. A similar research finding was corroborated by Gubba (2010) who conducted a research on effect of Cooperative Learning on academic achievement and retention of the mathematics concepts learning of Sixth Grade students at primary school in Holy Makkah in Saudi Arabia. It found a statistical significant difference of 0.05 between the means of the performance of both groups on the achievement and retention levels.

In a similar dimension, Slavin (2013) conducted a study on effects of cooperative learning and embedded multimedia on mathematics learning in key stage 2; final report. The results indicated that there was a positive effect of cooperative learning in mathematics in other countries. Similarly, Orprayoon (2014) examined the effects of Cooperative Learning on learning achievement and group working behavior of junior students in modern French literature course. The analysis of Pre-test and Post-test scores showed Cooperative Learning method raised significantly the students' learning achievement at 0.01 statistical levels. Also, Capar & Tarim (2015) reported that Cooperative Learning was more successful method than traditional method with regard to both achievement and attitude, in study of efficacy of cooperative learning method on mathematics achievement and attitude.

More recently, Farzaneh & Nejadansari (2014) conducted a study on students' attitudes towards Cooperative Learning for teaching comprehension. The outcome showed that the participants generally indicated enthusiasm towards supporting the implementation of Cooperative strategies in teaching and learning. Additionally, Han (2015) investigated an empirical study on the application of Cooperative Learning to English listening classes. The results showed that cooperative learning could improve

learners' communicative competence significantly and cooperative learning was very effective in English listening classes.

To indicate an attitudinal response towards learning, (Akhtar, et al 2012) reported that students could develop different attitudes toward teamwork from their educational experiences.

Closely related was the research carried out by (Oludipe, Ojediran and Odueake 2013) who investigated the effectiveness of Cooperative Learning strategy on Nigerian junior secondary students' attitude towards learning basic science. The data analysis indicated that among other there were significant main effects of treatment on students' attitude towards basic science.

Another empirical research was undertaken by Gull & Shehzad (2015) on the use of Cooperative Learning in mathematics. The aim was to investigate the effects of Cooperative Learning on students' academic achievement. The researcher used quasi experiment design, with pre-test and post-test to compare the mean test scores. The results indicated that there was significant difference between scores of experimental group before and after intervention.

Using science as a research tool, Altun (2015) investigated the effect of Cooperative Learning on students' achievement on the science and technology course. The study involved 20 students of a private middle school in Istanbul. The results showed that the cooperative learning method had a favorable effect on learning. Similarly, Takallou & Veisi (2013) conducted a study to investigate implementing Cooperative Learning in a reading class. The finding revealed that Cooperative Learning had an overall significant effect on students' reading comprehension, however as both high and low-achievers in the experimental group expressed positive attitudes toward cooperative learning.

Another significant study was undertaken by Gok & Silay (2010) examined the effects of teaching of the problem solving strategies on the students' physics achievement, attitude, and motivation. The study used grade 10 students, comprising 46 students, 25 students for Experimental and 21 students for Control Group in Turkey. The results indicated that a problem solving strategy was more effective in using Cooperative Learning than Conventional teaching. Still in Turkey, *Altun, (2015) examined the effect of cooperative learning method on students' achievement and views on the science and technology. The study used 7 girls & 13 boys. The results showed that Cooperative Learning Method had a favorable effect on learning.*

On the other hand, Mohammadjani Tonkaboni (2012) undertook a comparative study between the effect of cooperative learning teaching method and lecture teaching method on students' learning and satisfaction levels. The study used the fourth grade elementary school students which consisted of 120 students (60 females and 60 male). The results showed that the cooperative learning teaching method has a higher effect on students learning than the lecture teaching method. Also, female students had higher satisfaction in learning levels in cooperative learning teaching method than their male counterparts. Similarly, Takallou & Veisi (2013) studied cooperative learning and noted a significant effect on students' reading comprehension as both the high and low

achievers in the experimental group expressed positive attitudes towards cooperative learning. In a related vein, *Slavin (1991) studied the effect of cooperative learning on students under the concrete operational stage and those of formal operational stage. The results showed that sixty – seven used cooperative learning with the traditional method, sixty – one percent of cooperative learning classes achieved significantly higher than test scores of the traditional classes. Slavin (1991) further realized that when students were recognized or rewarded in groups learning, the cooperative learning improved.*

Using mathematics as a parameter, Zakaria, Solfitri, Daud and Abidin (2013) studied the effect cooperative learning on secondary school students' mathematics achievement. The study involved 61 form three students divided into two groups; one consisted of 30 students in the control group while 31 students were in the treatment group. The results revealed that there was a significant difference of mean in mathematics students' achievement between the Cooperative Group and the Traditional Group. Also, the content analysis data showed that students in the Cooperative Group were able to increase their understanding and develop their self-confidence. Still in mathematics discipline, (Lavasani & Khandan, 2011) examined the effect of Cooperative Learning on mathematics anxiety and help seeking behavior. The researchers reported that Cooperative Learning method in comparison with the Traditional Group decreased mathematics anxiety in students significantly and avoidance component ( $p>0.05$ ) but increased their help seeking behavior. The study utilized 40 students from two schools randomly selected termed as experiment and control groups.

On a contrary note, (Park & Nuntrakune, 2013) studied a conceptual framework for the cultural integration of cooperative learning on mathematics for primary education in Thai. The study used a teacher and thirty- two grade 4 students of primary school. The results indicated that the three components including preparation of teachers, instructional strategies and preparation of students could be the vehicles for the cultural integration in cooperative learning.

Using a different research tool, (Hwang, et al, 2005) examined an empirical test of Cooperative learning in a passive learning environment. The study used one hundred and seventy-two accounting students from a University. The results showed that Cooperative Learning was an effective teaching pedagogy for delivering accounting topics in a passive learning environment.

The literature have clearly demonstrated the effectiveness of cooperative learning methods over traditional / lecture method of learning performed better in their Posttest (Sherman and Thomas 1986; Slavin 1991; Gubba 2010; Aziz, Nordin and Hossain 2010; Leikin and Zaslaysky 2013; Capar and Tarim 2015; Maulana 2017; Alpat, Uyulgan, Seker, Altas and Gezer 2017; Parveen, Yousuf and Mustafa 2017; Saad 2017; Pandya 2017). Furthermore, studies have indicated that Cooperative learning methods was more successful method with respect to positive attitude and motivation (Akhtar, Perveen, Kiran, Rashid and Satti 2012; Park and Nuntrakune 2013; Oludipe et al 2013; Orprayoon 2014; Farzaneh and Nejadansari 2014). The bulk of proof regarding



Cooperative learning methods would advocate it to be a viable substitute to traditional method of learning for learning mathematics.

### 3. Conclusion

Cooperative learning strategy increased mathematics achievements, fostered interest of students in mathematics learning, enhanced understanding and self-confidence. The results imply that incorporating of cooperative learning in the mathematics curriculum is vital. In this case, teachers should be trained to produce better work. By talking and discussing with others, the mathematics content is no longer an item to be memorized and too abstract. The preparation and presentation were both challenging and relevant, leading to higher participation among students.

Another skill that was derived from this paper was that students felt comfortable to get clarification from their peers on content that was blurred. This means that the classroom ambience is no longer threatening that students are able to contribute to the learning.

Finally, the literature indicated that cooperative learning in the classroom has a positive effect on students' achievement and attitudes toward mathematics if it is properly implemented.

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