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A STUDY OF COOPERATIVE LEARNING ON STUDENTS MATHEMATICS TEST SCORES IN CLASS 10TH

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Abstract

Mathematics is still a subject that is considered difficult and boring to many students. According to Woodard (2014), weaker students feel anxiety toward mathematics, and this anxiety affects their performance in mathematics. Therefore, to enhance the understanding of mathematics, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving mathematical problems. Students should be given the opportunities to develop, to interact, and to share with friends through cooperative learning activity. Thus, the cognitive and affective development of students in mathematics can be improved. An alternative method for the delivery of material is cooperative learning.

Co-operative learning is defined as students working together to "attain groups goals that cannot be obtained by working alone or competitively". The main purpose of co-operative learning is to actively involve students in the learning process, a level of student empowerment which is not possible in a lecture format. The purpose of this study is to investigate the effects of cooperative learning methods and collaborative learning technique on 10th grade students' achievement in mathematics lesson. Preliminary findings indicate a positive correlation between cooperative learning and improved mathematics test scores. Students participating in cooperative learning activities demonstrate heightened problem-solving skills, a deeper understanding of mathematical concepts, and increased overall performance compared to their peers in traditional learning environments. The collaborative nature of the approach fosters a supportive and interactive classroom culture, promoting teamwork and communication skills. Cooperative learning fosters social interaction and teamwork, enhancing communication and interpersonal skills. It promotes active engagement, critical thinking, and problem-solving among participants. Additionally, it creates a supportive learning environment that accommodates diverse learning styles and encourages positive interdependence.

Keywords: *Co-operative learning, mathematics, learning, Dyscalculia*

Introduction

At present mathematics is widely used in various fields and covering a wide range of activities. Mathematics is a problem not only in our country but also in many developed countries. Students who lack mastery in mathematics are less successful, despite being in secondary schools for a long period of

time. Based on observations of high school mathematics students, the information shows that students are not actively involved in developing knowledge; they receive information passively and are less motivated. This passivity has caused much concern among educators because knowledge of mathematics plays a significant role in enhancing the country's social economic development. The quality of education that teachers provide to students is dependent upon what teachers do in their classroom (Zakaria, 2017). Ariyania (2013) observed that unconventional teaching methods have among other factors been responsible for the low performance exhibited by the students in mathematics. This study aims to provide a practical way to assist students learn better. This predicament could be overcome using a cooperative learning strategy which has been identified as one of the ways teachers may apply to increase academic achievement and ensure active learning among students (Narzoles, 2015). Many studies have been conducted and conclusions have shown that cooperative learning strategy is a helpful instructional strategy which promotes students' learning achievement (Van Dat, 2016). The teaching method used in the class is one of the factors that make students become passive and have less interaction with each other in doing tasks. Lazarowitz (2014) have criticized the lecture method use by teachers because only hardworking students can benefit from it.

Researchers studied in various countries have showed that teachers and teaching methods were effective in this issue. This research has indicated that teaching methods used in schools are simple expression method and mutual studies, small group works or alternative studies are not placed and education system based on rote. Therefore, instead of giving information by heart, methods and techniques, which activity students, should be used (Sengul and Ekinozu, 2004). Because of the fact that methods and techniques, which allow the active participation of students in the learning-teaching process, are applied, the students learn and remember better and faster and enjoy what they do (Oral, 2000). However, the decline in mathematics achievement is of concern. Among the reasons of the decline in mathematics achievement in schools is because students consider mathematics as a difficult and boring subject. According to Keefe (1997), the phenomenon of frustration among teachers and students needs to be overcome in order to achieve excellence in mathematics. Therefore, teachers should take note of the needs of individual students. According to him, the individual needs of students should be treated accordingly so that the teaching and learning is effective. Mathematics achievement is often discussed by educators in our country.

Co-operative study shows that students ask questions each other, discuss their ideas, make mistake, learn to listen and make constructive criticism thanks to cooperative group work. It points out the role of learning mathematics because of paving the way for mathematical knowledge. Co-operative teaching method provide to students both academic and social benefits (Gillies, 2002).

Cooperative Learning

Cooperative learning has evolved as a major new approach to classroom instruction during the last decade (Bahman, 2014). Faculty members from various educational areas use cooperative learning exercises as part of their teaching strategies (Tisha L.N. et al.,2016). As compared to other traditional teaching methods, Cooperative learning is more effective at improving students' awareness, interpersonal skills, and motivation. The study of Valdez et al. (2015) showed that students become more involved in the learning process according to their pace and freedom of participation because of cooperative learning. Furthermore, the study also revealed that the strategy is very effective for improving students' ability to think and avoiding misconceptions of ideas that may arise if teachers continue to teach in the traditional strategy.

Cooperative learning is one of the many ways for effective mathematics teaching. Whether in an educational context, students have always learnt by actively interacting with their surroundings. Learners who study mathematics under the guidance of experienced teachers will be able to perform basic calculations and be far ahead in their knowledge and preparedness for higher mathematics. To achieve educators' goals of developing proficient individuals who will lead the next generation, innovative teaching strategies such as cooperative learning must be established. Utilization of the said strategy will

advance through identifying the effects it can cause in students' academic performance, specifically in mathematics, hence this study.

There are many different cooperative learning techniques. These are:

1. Team- game- tournament
2. Team supported personalization
3. Unified collaborative reading and writing
4. Group research
5. Cooperation-cooperation
6. Combination
7. Invention
8. Let's ask together and learn
9. Student teams-Success sections

Objective

- To Evaluate the impact of cooperative learning on students' mathematics test scores to determine if this teaching approach enhances academic performance.
- To Measure the extent in which cooperative learning contributes to individual and collective learning gains in mathematics compared to traditional teaching methods.
- To Develop methods to assess and quantify individual contributions within group settings, providing insights into the fair evaluation of students' performances.
- Examine the impact of cooperative learning on students' motivation and engagement in mathematics, considering factors such as interest, participation, and sustained focus.

How does cooperative learning work?

Self-Determination Theory indicates that individuals have specific psychological needs such as belonging (being accepted and feeling part of a group), competence (experiencing a sense of mastery) and autonomy (feeling a level of control). All of these needs can be met when students learn to work with others in small, cooperating groups. Having their psychological needs met also contributes to students' enjoyment of cooperative learning.

Forms of cooperative learning: Cooperative learning can be informal, formal or long-term and student team-achievement division (STAD).

Informal cooperative learning

It involves students working in small groups for a few minutes to help them process what has been taught, to think about a particular question, to assist the teacher to identify and address any misunderstandings about the content, and to quickly recap on the key points in the lesson. Teachers often break up their teaching by asking students to spend a few minutes in pairs or groups discussing a particular topic that is relevant to the lesson. Informal cooperative learning provides opportunities to listen to others and hear what they think about a particular issue that has been raised in the lesson.

Formal cooperative learning

It consists of students working together for a designated period of time over a few weeks to achieve shared learning goals and jointly complete specific tasks and assignments. Formal cooperative learning groups are structured so students understand that they are required to work together to support each other's learning, share their ideas and information with the group, listen respectfully to what others have to say, and ensure that the group reflects on the progress they are making in order to determine if changes need to be made to how they manage the task. A long-term structure for cooperative learning involves base groups, which are long-term, heterogeneous cooperative learning groups with stable membership.

The Student Teams-Achievement Divisions (STAD)

These were found to be the most successful cooperative learning technique at increasing student academic achievement but the bulk of the research on STAD had been conducted at the elementary level. This cooperative learning approach consistently had positive effects on learning in many studies.

Methodology: In this study of co-operative learning on students' mathematics test scores, both primary and secondary source of data have been used. Primary data has been collected through survey and tests bases on the topic chosen for students learning and observations. Secondary data have been collected via relevant journals, articles, books, etc.

- Initially, a group of 40 students were chosen, and they were made to appear for a test on the topic "Comparing Quantities".
- Pre-test contained objectives and subjective questions of total 20 marks. Each question was allocated 2 marks. The time allocated is 40 minutes.
- All questions used are based on the mathematics syllabus. The children appeared for the pre- test and the marks they obtained are shown below in the chart. This study was performed in three different schools.

Results and Discussions:

SCHOOL- I							
GROUP-I	**TEST-SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	1	11	12	21	9	31	17
2	18	12	1	22	18	32	1
3	8	13	17	23	15	33	17
4	8	14	14	24	20	34	8
5	12	15	8	25	13	35	8
6	11	16	20	26	11	36	3
7	20	17	3	27	11	37	19
8	11	18	11	28	16	38	4
9	5	19	8	29	11	39	14
10	1	20	19	30	9	40	8

SCHOOL - II							
GROUP-I	**TEST SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	1	11	12	21	9	31	17
2	18	12	1	22	18	32	1
3	8	13	17	23	15	33	17
4	8	14	14	24	20	34	8
5	12	15	8	25	13	35	8

6	11	16	20	26	11	36	3
7	20	17	3	27	11	37	19
8	11	18	11	28	16	38	4
9	5	19	8	29	11	39	14
10	1	20	19	30	9	40	8
SCHOOL – III							
GROUP-I	**TEST SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	13	11	15	21	19	31	12
2	12	12	18	22	16	32	19
3	16	13	15	23	17	33	18
4	10	14	7	24	11	34	5
5	9	15	13	25	13	35	12
6	10	16	8	26	9	36	16
7	17	17	16	27	14	37	13
8	12	18	3	28	10	38	5
9	8	19	9	29	12	39	11
10	12	20	7	30	9	40	10

- Next, cooperative learning method was applied to the same group of students, wherein, students learnt the same concept using the STAD learning style.
- However, the students are now divided into four different groups, each comprising of 10 students. The students have been put together in such a way that every group has a mix of different levels of intelligence, capacity, ethnicity and gender.
- Post test, also contained objectives and subjective questions of total 20 marks. Each question was allocated 2 marks. The time allocated is 40 minutes.
- All questions used are based on the mathematics syllabus. The marks scored by the different groups are shown below:

SCHOOL-1							
GROUP-I	**TEST-SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	4	11	6	21	20	31	15
2	19	12	10	22	20	32	19
3	10	13	10	23	18	33	6
4	11	14	17	24	15	34	18
5	13	15	20	25	18	35	11
6	11	16	10	26	15	36	10

7	20	17	19	27	14	37	6
8	12	18	7	28	15	38	20
9	10	19	10	29	18	39	9
10	4	20	9	30	12	40	15

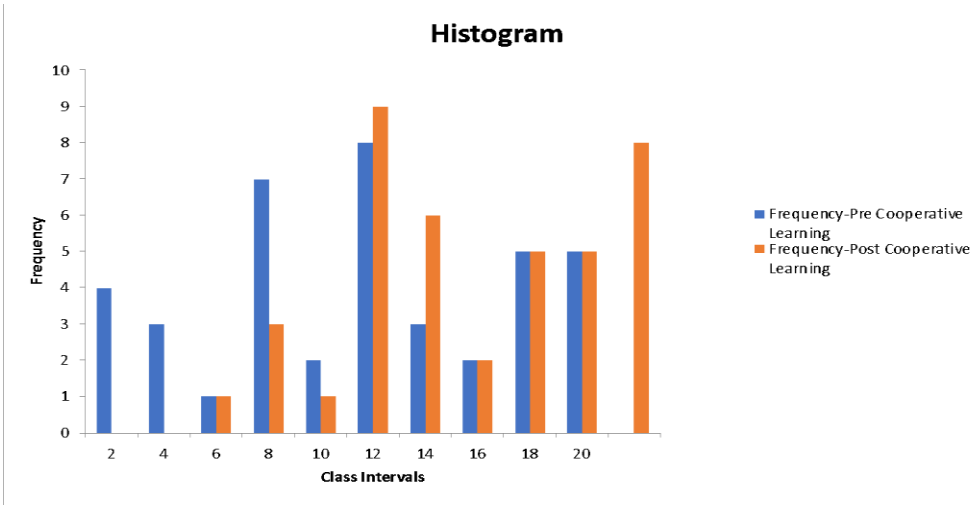
SCHOOL-II							
GROUP-I	**TEST-SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	20	11	16	21	15	31	20
2	18	12	19	22	19	32	20
3	20	13	17	23	12	33	20
4	12	14	15	24	15	34	13
5	13	15	14	25	14	35	16
6	14	16	11	26	12	36	20
7	20	17	18	27	17	37	6
8	15	18	9	28	16	38	9
9	12	19	12	29	17	39	9
10	10	20	10	30	12	40	15

SCHOOL-III							
GROUP-I	**TEST-SCORE**	**GROUP-II**	**TEST SCORE**	**GROUP-III**	**TEST SCORE**	**GROUP-IV**	**TEST SCORE**
1	16	11	16	21	20	31	20
2	18	12	19	22	19	32	20
3	19	13	17	23	18	33	20
4	15	14	15	24	15	34	13
5	13	15	14	25	14	35	16
6	14	16	12	26	12	36	20
7	20	17	18	27	17	37	16
8	16	18	10	28	16	38	9
9	15	19	12	29	17	39	14
10	14	20	10	30	12	40	15

Data were analysed to determine performance by comparing the mean and standard deviation of the pre-test and post-test as shown below.

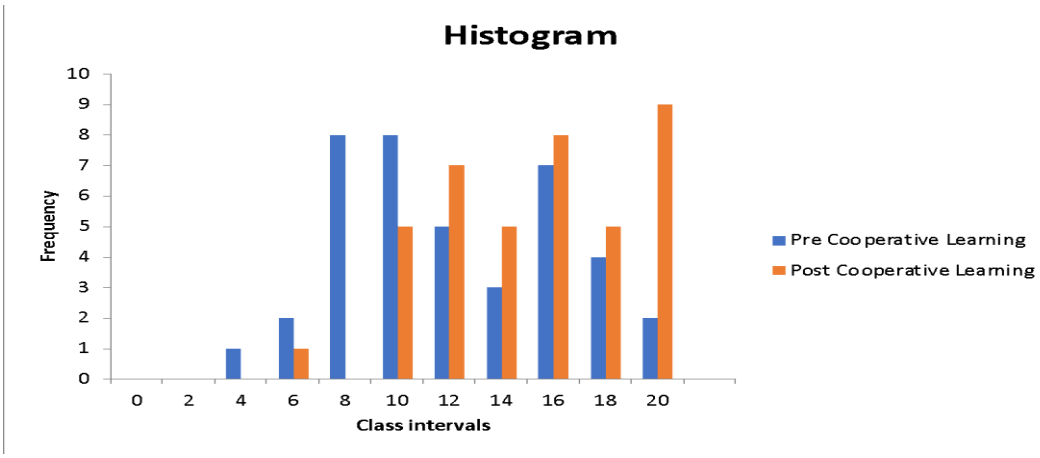
SCHOOL-I				
	MEAN	**MEDIAN**	**MODE**	**STANDARD DEVIATION**
PRE-CO0PERATIVE LEARNING	11	11	8	5.8
POST-COOPERATIVE LEARNING	13.4	12.5	10	4.7

SCHOOL-I HISTOGRAM

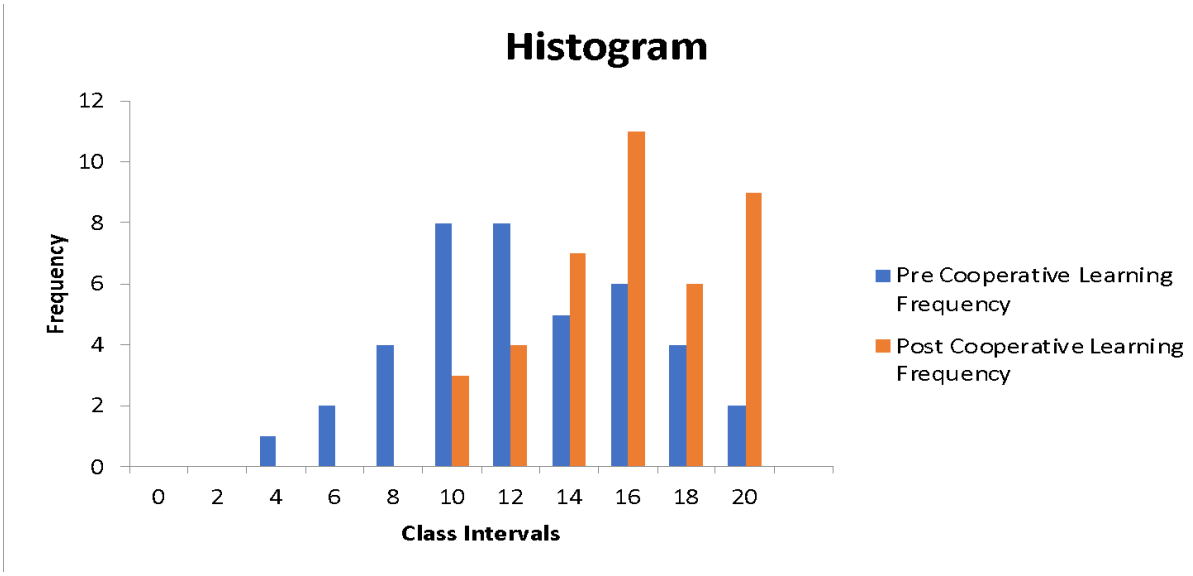


SCHOOL-II				
	MEAN	**MEDIAN**	**MODE**	**STANDARD DEVIATION**
PRE-CO0PERATIVE LEARNING	**11.6**	**11**	**16**	**4.1**
POST-COOPERATIVE LEARNING	**14.8**	**15**	**20**	**3.7**

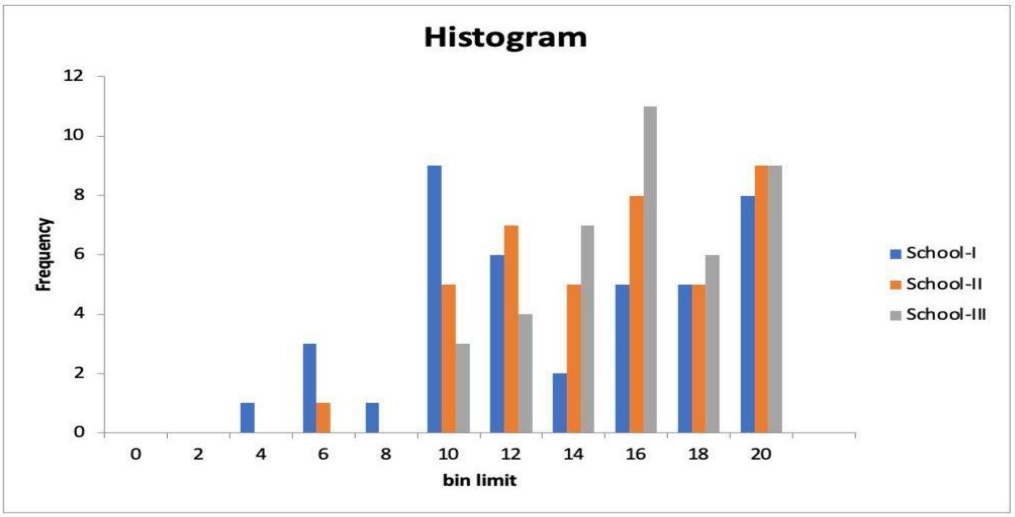
SCHOOL-II HISTOGRAM



SCHOOL-III				
	MEAN	**MEDIAN**	**MODE**	**STANDARD DEVIATION**
PRE-CO0PERATIVE LEARNING	12.02	12	12	3.9
POST-COOPERATIVE LEARNING	15.6	16	16	3



Furthermore, all the mathematics score from the three different schools also has been compared as shown below to get an idea of how the scores of the students varied.



The results of this study showed that cooperative learning methods improve students' achievement in mathematics and attitude towards mathematics. Cooperative learning is an effective approach, which mathematics teachers need to incorporate in their teaching.

Findings

Based on the findings of the study, the Student Teams-Achievement Divisions (STAD) Cooperative Learning Strategy is better than the non-STAD cooperative learning strategy in enhancing students' mathematics achievement and is more effective in enhancing students' teamwork skills, specifically on positive interdependence, interpersonal relations, individual accountability, and team leadership. This approach encouraged students' independence and team learning, developed individual and group accountability practiced and developed different teamwork skills, and improved their achievement scores in mathematics. They became more aware of their responsibility in enhancing their teamwork skills while learning the mathematics content. High School mathematics teachers may employ the Student Teams-Achievement Divisions (STAD) Cooperative Learning Strategy in teaching mathematics to increase both the mathematics achievement and teamwork skills of the students. It is found to be better than the conventional small group cooperative learning strategy, especially in controlling common team problems like free-riders in a group. Thus, ensuring maximum participation of each team member. School administrators may provide opportunities for the dissemination of the research result and the proper employment of the STAD cooperative learning strategy to high school teachers in mathematics and to recommend it in their classes to help the students improve both their mathematics achievement and teamwork skills. Further studies may be conducted to investigate the effectiveness of STAD cooperative learning strategy in the development of the students' teamwork skills with a wider scope using different populations, setting and time. It may be conducted to more grade levels especially the heterogeneous classes for the whole school year and analyse the result every grading period.

Challenges faced: Implementing cooperative learning in a Class 10 mathematics setting presents several challenges: Resistance to Change: Students and even teachers may resist adopting a new learning approach, requiring effective communication and support to foster acceptance.

- Group Dynamics: Managing group dynamics can be challenging, as ensuring equal participation, resolving conflicts, and maintaining a positive collaborative atmosphere can be complex.
- Time Constraints: Incorporating cooperative learning may seem time-consuming, especially when there is pressure to cover a specific curriculum within a limited timeframe.
- Varying Learning Styles: Students have diverse learning styles, making it challenging to create cooperative activities that cater to everyone's preferences and needs.
- Assessment Difficulties: Assessing individual contributions within a group setting can be tricky, as it may not always reflect each student's true understanding of the material.
- Resource Constraints: Limited access to materials, technology, or sufficient space for group activities may hinder the effective implementation of cooperative learning strategies.
- Teacher Training: Teachers may require additional training to effectively manage and facilitate cooperative learning, including handling diverse abilities and maintaining class control.
- Logistical Issues: Organizing and coordinating group activities, ensuring everyone is on the same page, and managing transitions between collaborative and individual work can pose logistical challenges.

Addressing these challenges involves a combination of teacher training, creating supportive learning environments, adapting activities to student needs, and continuous monitoring and adjustment throughout the implementation process.

Solution on challenges faced: To address challenges in a study of cooperative learning on Class 10 students' mathematics test scores:

- Equal Participation: Implement structured group roles, rotate responsibilities, and provide clear guidelines to ensure all students contribute actively.
- Varying Skill Levels: Incorporate differentiated tasks that cater to diverse skill levels, promoting collaborative learning where stronger students assist others, fostering a supportive environment.
- Measuring Individual Contributions: Utilize both group and individual assessments to evaluate students' understanding and performance. This can include peer evaluations and reflections.

- Student Motivation: Integrate engaging activities, real-life applications, and varied teaching methods to enhance student interest and motivation in mathematics.

Teacher Training: Provide teachers with training on effective cooperative learning strategies, communication skills, and ways to manage group dynamics to ensure successful implementation.

- Controlled Study Environment: Establish a controlled environment by minimizing external influences, maintaining consistent testing conditions, and ensuring adherence to the study protocol to enhance the study's validity.
- Continuous Monitoring: Regularly assess and adjust the cooperative learning approach based on ongoing observations and feedback to address evolving challenges and ensure the study's accuracy.

Benefits and Advantage of Cooperative learning: The benefits that students derive from working cooperatively together have been well documented and include academic gains, possibly because students have opportunities to share their knowledge and in so doing often develop clearer understandings of what they are learning. When students have opportunities to work with others, they learn to listen to others, consider their perspectives on a topic, challenge other's ideas, and communicate in a way that is acceptable to the group. These are behaviours that help to build positive working relations as students learn to understand that there are ways of behaving in the group that they need to accept if they are to continue working constructively with their peers. This way of working also contributes to higher levels of self-esteem for students. Other benefits that have been attributed to cooperative learning include less need to discipline as the group will often remind a student who becomes disruptive of the need to settle down and work on completing the task. Cooperative learning also promotes greater acceptance of others, and students will often use language that is more inclusive of others such as 'we' or 'us. They also learn to provide more detailed help or explanations to their peers as they are asked to explain information or to help with a problem. It also allows more time for peer learning and teacher assistance, as peers learn from each other with the teacher providing assistance as needed. Cooperative learning involves an emphasis on the diversity rather than uniformity of instruction, which means that teachers can ensure that students are given tasks that they have the potential to accomplish. It also permits greater flexibility to adjust learning objectives, as teachers can adjust tasks to meet the needs of specific students in groups. As students orally rehearse material, explain it to others, discover solutions, debate and discuss procedural issues in small groups, they consolidate their own learning as well as contributing to the learning of others. Cooperative learning provides opportunities to promote higher order thinking skills and develop social and communication skills, and it motivates students to learn information. Working in small cooperative groups particularly benefits lower achieving students, as it provides opportunities to have the learning repeated and reinforced in different ways that help consolidate learning.

How to construct group: Research offers a number of guidelines as to the best ways to construct groups for cooperative learning:

- Groups of 3-4 students are better than larger groups, although it is important to consider the time limits, group-work experience and age of the students, and the materials and equipment available when deciding the size of a group.
- Mixed ability groups are better than same ability groups (groups of one high-, two medium-, and one-low ability student is one of the better mixed-ability combinations).
- Balanced group for gender, all male or all female groups seem to encourage more interactions among members.
- Friendship groups may be better with adolescents.

Once the groups have been established, it is important to establish positive interdependence and ensure that all group members understand what the group task is and how everyone is required to participate. Group members may need explicit training in interpersonal and small-group skills. It is also beneficial to give group members time at the end of the session to discuss group processes.

The Key Elements of Cooperative learning: Cooperative earning involves five key elements:

- The first is positive interdependence, or the attitude that 'we sink or swim together'. Positive interdependence exists when students perceive that they are linked to other members in the group in such a way that they cannot succeed individually unless the whole group succeeds, and they must coordinate their efforts with each other in order to complete the task.
- The second key element is individual accountability, which involves each student:
    - Being responsible for part of the task
    - Reporting to the group on their progress
    - Reporting on the group's progress to the whole class
    - Being rewarded on the basis of all group members completing their tasks/goals
    - When they have individual accountability, students adopt the attitude that they will contribute because they know they have something valuable to offer the group.
- The third key element is promotive interaction, which describes individuals encouraging and facilitating each other's efforts to complete the task and achieve the group's goals. Students use their material, emotional and interpersonal resources to work for the best outcome for their group. Promotive interaction leads to students being motivated to strive for mutual benefits and feeling less anxiety and stress. It involves students:
    - Providing each other with efficient and effective help and assistance, exchanging needed resources
    - Providing each other with feedback in order to improve their continuing performance on tasks
    - Challenging each other's conclusions
    - Advocating efforts to achieve mutual goals
    - Influencing each other's efforts to achieve mutual goals
    - Having faith and trust in each other
- The final key element is group processing, which involves reflecting on a group's session by describing which actions were helpful and unhelpful and making decisions about which actions to continue or change. Group processing is critically important for student learning as it allows members to discuss how well they are achieving their goals and maintaining effective working relationships. Research suggests that both teacher-led and student-led discussions promote greater success in problem-solving and achievement gains than students involved in cooperative learning who did not follow-up with processing their experiences in groups.

Conclusion

Cooperative learning promotes social interactions; thus, students benefit in a number of ways from the social perspective. By having the students explain their reasoning and conclusions, cooperative learning helps develop oral communication skills. Because of the social interaction among students, cooperative learning can be used to model the appropriate social behaviours necessary for employment situations. By following the appropriate structuring for cooperative learning, students are able to develop and practice skills that will be needed to function in society and the workplace. These skills include leadership, decision-making, trust building, communication and conflict management. The outcomes of this study revealed the potential benefits of incorporating cooperative learning methods in mathematics education at the high school level. Educators and policymakers may consider integrating collaborative approaches into the curriculum to foster a more interactive and engaging learning environment. The study also highlights the importance of promoting teamwork, communication, and mutual support among students, contributing not only to academic success but also to the development of essential life skills. The study on cooperative learning's impact on students' mathematics test scores reveals noteworthy insights. The findings suggest a positive correlation between the implementation of cooperative learning strategies and improved performance in mathematics assessments. Students engaged in collaborative learning exhibited enhanced comprehension, problem-solving skills, and overall test scores compared to those in traditional learning environments. While the positive trends observed in this study are promising, further research is

recommended to explore the long-term effects of cooperative learning on students' mathematical proficiency and to identify specific strategies that yield the most significant improvements. Overall, the study reinforces the value of cooperative learning as a pedagogical approach for enhancing students' mathematics test scores in Class 10.

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