

# Enhancing Grade Six Students' Mathematics Achievement through the Use of Cooperative Learning Strategy: An Action Research

## Abstract

This study examined the effectiveness of implementing cooperative learning strategies in teaching Mathematics to the grade six students. Quantitative data was gathered through pretest and posttest, and qualitative data was gathered through open-ended interviews. The quantitative data was then analyzed using paired sample t-test and the qualitative data was analyzed using thematic analysis. The data analysis showed a significant improvement in students' post-test scores ( $M=14.5$ ) compared to the pre-test scores ( $M=7.1$ ). Similarly, analysis of open-ended interview data revealed that the students possess positive mindset towards the use of cooperative learning strategies in learning mathematics.

The students preferred cooperative teaching learning strategies over the traditional teaching methods. Therefore, the study recommends all Mathematics teachers to use cooperative teaching learning approaches to enhance students' performance.

**Key Words:** *Mathematics, Achievements, Cooperative learning Strategy*

## Introduction

Mathematics occupies a very important position in the Modern World. It is essential in many fields: including measurement, fashion, sports, technology, and economics. Realizing the facts, it is taught at all levels of education, to build the students' mental capability, teach logical reasoning, critical thinking, analytical and problem solving skills. Mathematicians and other scholars in different fields of study have given different definitions of mathematics based its application. [1] described "mathematics as a tool for enhancing the learning of other school subjects; an essential instrument for solving problem conditions in all fields". [2] asserted that "mathematics is a dynamic field of knowledge which has much to offer in the sciences, technology, arts, everyday living as well as entrepreneurship development".

Mathematics is highlighted as one of the core subject in primary and secondary school education in Bhutan. [3] stated that "Mathematics had always been featured as a core and compulsory subject in the schools of Bhutan". [4] found out that "Mathematics curriculum has undergone gradual transformation which were aligned with constructivist theories and in

year 2008, the curriculum was transformed which ensured student centred and implemented in the schools of Bhutan”. However, “the learning achievement of Bhutanese learners in Mathematics is still found low as compared to the rest of the subjects. A study conducted by the National Council of Bhutan revealed that many learners had performed below expectations of their grade level on both basic and advanced academic skills, lacked basic communication and analytical skills. The same concern was restated by the Education Minister during the 17th Session of the National Council, on average a learner required one additional year to achieve the same level of competency for that grade” [5]. Based on the citation, the level of educational performance of most Bhutanese learners were below expectation which meant the performance level of mathematics curriculum is low as well. Thus, the decline in mathematics achievement is a concern. Among the reasons of the decline in mathematics achievement in schools one of the reason is students consider mathematics as a difficult and boring subject.

Hence, cooperative learning strategies are always a stimulating approach for pupils to overcome common challenges. “Cooperative learning has received wide attention among researchers as an educational learning strategy because of its numerous positive effect on both the teacher and the learner. It works to improve the teacher's professional performance. It turns the learner into an effective element in the educational process. It allows him to practice dialogue and debate, increase academic achievement and psychological harmony, and develop problem-solving skills. Cooperative learning is one of the ways that seeks to organize the group's work, intending to enhance learning and developing academic achievement, through an accurate structural organization of how the learner interacts with other learners and their participation together to achieve the goals” [6].

The teacher researchers believe that the institution and implementation of cooperative learning strategies would help in improving students’ performance in mathematics.

### **Aims and Objectives:**

1. Examine the impact of cooperative teaching strategy on the academic performance of grade six students in Mathematics.
2. To study differences in the mean achievement scores of grade six students in Mathematics after the interventions.

### **Reconnaissance**

This is derived from a French word (reconnaitre – to look at) and has connections with warfare (to survey the scene to find out strategic points of interest). According to [7] “it

consist of three part namely: situational analysis, analysis of competence of the people involved, and 'literature'. Together these comprise an overview that will encompass the realities of the situation in terms of resources and practices (situational analysis), the profile of competences of key players (competences) and a connection with previous work in this and related areas ('literature')”.

### **Situational Analysis**

Having taught Mathematics for more than 19 years at different grades in various schools of Bhutan especially in primary classes, inference drawn is that majority of students in the eastern of Bhutan are academically indifferent towards learning mathematics owing to the nature and complexity of the subject. This issue has become more apparent and demands greater attention after teaching mathematics to class six students for last four years and having discussed with colleagues who shared same concerns. If this issue is left unattended, the teacher researchers foresee bigger consequences in the lives of students and teachers. [8]expressed that “mathematics is not just computation but a tool for understanding structures, relationships and patterns to produce solutions for complex real life problems. So mathematics, as a subject and career is indispensable in our everyday activity and most importantly in the world of science, technology and engineering”.

The poor performance in Mathematics is caused by several factors. [9] assert that “one of the main reasons that lead to the poor performance in Mathematics is because the students assume that Mathematics is boring and difficult to master”. “Learning by memorizing and conventional learning will create students who are good at counting. However, they will not understand the concept of Mathematics and will not be able to apply the concept or skills of Mathematics in solving daily problems. In such, students become passive recipient of knowledge and resort to rote learning” [10]. Therefore, “teachers should identify and use effective teaching methods to increase the students’ understanding and mastery of Mathematics. Previous researches proved that the application of co-operative learning is not only able to improve the students’ performances, but it is also capable of increasing the social and interaction skills between students and teacher” [10].

Thus, the researchers felt the need to identify the problems of low performing students and enhance their academic performance in mathematics with the implementation of cooperative learning strategies.

## **Literature Review**

Cooperative learning encourages students to interact and to communicate with peers in harmony. In this way, cooperative learning promotes values such as honesty, cooperation, mutual respect, responsibility and tolerance

[11] defined “cooperative learning (CL) as an instructional strategy in which students work actively and purposely together in small groups to enhance both their own and their teammates learning”. [12] sees “cooperative learning as one of the best studied pedagogical strategies in the history of educational research, with over 1,000 research studies and hence noted that cooperative learning have been demonstrated in countless studies and several meta-analyses”. [13]”cooperative learning is defined as the instructional strategy in which small groups of students work together to accomplish shared learning goals. Cooperative learning by its nature is a very active learning method. Moreover, cooperative learning is a student-centered and instructor-facilitated instructional strategy in which a small group of students are responsible for its learning and the learning of all group members”.

[14] provides “several benefits on the use of cooperative learning approach for students. First, cooperative learning promotes deep learning of materials. Second, students achieve better grades in cooperative learning compared to competitive or individual learning. Third, students learn social skills and civic values. Fourth, students learn higher-order, critical thinking skills. Fifth, cooperative learning promotes personal growth. Finally, students develop positive attitudes toward autonomous learning”. [15]examined “the attitude of prospective teachers regarding cooperative learning and its potential effect on them and found that prospective teachers had an overall positive attitude towards cooperative learning and had a significant effect on their pupils which increased the likelihood of its use by them in future”.

[16] found that “cooperative learning improves students’ achievement in mathematics. Further, cooperative learning is an effective approach that mathematics teachers need to incorporate into their teaching”. “Cooperative learning promotes deep learning of materials and helps students to achieve better grades” [14].

[17] concluded that “the cooperative learning method is more effective than the traditional teaching method in the academic success of students”. [18] embarked “on a study to determine the effects of cooperative learning over the conventional teaching method in matriculation level mathematics. He found cooperative learning improved students’

achievement in mathematics and attitudes towards mathematics. He concluded that utilization of cooperative learning method is a preferable alternative to traditional instructional method". [19] examined "the effects of cooperative learning on the achievement and attitudes towards mathematics of a group of fifth graders. The students participated for twelve - weeks in cooperative learning in mathematics. The analysis of pre- and post-test scores revealed positive changes in attitudes and achievement". According to [20], "cooperative learning should not exclude mathematics simply because it is more challenging for teachers to teach this way. Instead, it should be included to facilitate full reasoning and understanding for both students and teachers". [21] indicated that "the use of manipulatives and cooperative learning strategies improved the learning achievement of students. Similarly, analysis of semi-structured interview data revealed that the students developed positive perceptions towards the use of manipulatives and cooperative learning strategies in learning mathematics". [22] explored "the Effectiveness of jigsaw cooperative learning approach in mathematics and found out that a jigsaw cooperative learning approach brings improvement in learning achievement compared to traditional teaching. The study also showed a positive correlation between qualitative and quantitative findings. The students preferred the jigsaw over the traditional teaching method".

The reviewed literature reflects solid support for using cooperative learning in the mathematics classroom as well as in all classrooms. A common theme throughout the literature reflects that as students work in cooperative groups, they gain a deeper understanding of concepts.

The study therefore investigated the effect of cooperative learning strategy on student's learning experience and achievement in mathematics.

### **Overarching Research Question**

How Can We Improve Grade VI Students' Mathematics Achievement with the use of Cooperative Learning Strategies?

### **Sub Questions**

1. What is the mean achievement score of students in Mathematics before the implementation of cooperative learning strategies?
2. Do implementation of cooperative learning strategies help in enhancing the Mathematics achievement of students?

3. Are there any significant differences in the Mathematics achievement of students before and after implementing CLS?

### **Methodology**

The researchers utilized mixed method approach in this study. The pre-test and post-test were used to collect quantitative data in order to determine the learning achievement, while open-ended interview was conducted for collecting qualitative data on students' views about the use of cooperative learning strategies.

### **Sample**

The study used a convenience sampling technique. The total sample size in the study consisted of 19 students (9 boys and 10 girls) studying in grade six in Rongthung Primary school, Tashigang. Since there was only one section of grade six, all of them participated in the study. Their age ranged from 10 to 13 years with mixed genders and abilities in mathematics.

### **Research instruments**

In this study, two instruments were used to collect the data namely subject achievement tests (pre-test and post-test), and open-ended interviews. The teacher researchers used self-developed instruments both for subject achievement test and open-ended interview. The subject achievement test (pre-test) was conducted before the implementation of the interventions to establish the baseline knowledge of the students while the post-test was conducted to assess how much students have learned after the interventions. A set of questions consisted of multiple choice questions and short answer questions with the weightage of 20 marks, of which 10 marks was allotted to multiple question while another 10 marks were allotted to the short answer questions. The open-ended interview was conducted to gather students' views about integration of cooperative learning strategies in the mathematics classes.

### **Reliability**

To check the reliability of the achievement test, the researchers conducted a pilot test with a different group in the same research school. The Kuder-Richardson formula (KR-20) was applied to find out the reliability coefficient of the subject achievement test. The result showed a score of 0.86, which was an indication that the test items were reliable.

### **Data Analysis techniques**

The study employed descriptive and inferential analysis techniques in representing the research findings. The pre and post data collected from subject achievement test were analysed using Statistical Package for Social Science (22.0 version) software and the findings were presented in mean, standard deviation, t-test, and frequencies. Out of 19 participants, only 11 students participated in the open-ended interviews and the results were analysed using the theme based method.

### Implementation of Interventions

Interventions are the activities that researchers implement on an on-going basis in order to meet the objectives. There are many approaches or methods which can be adopted in improving students' academic achievement and for this particular study various cooperative learning strategies such as Jigsaw puzzles, Manipulatives, Number Heads Together, Jot Thought, Mix- Pair share, Inside-Outside circle and Rally table were implemented to teach different Mathematics concepts. The researchers conducted the interventions for three months. After the interventions period post data was gathered through subject achievement test and open-ended interview.

### Results and Interpretations

The paired sample t-test was used for statistical analysis of the learning achievement test. Comparisons were made based on the mean, significant value and standard deviation. The differences in student learning achievement by comparing the pre-test with the post-test were determined.

**Table 1** Individual student's pre-test, post-test and improvement scores

Student Number	Pretest Score (20)	Posttest Score( 20)	Improvement Scores
1	5.5	11	5.5
2	7	17	10
3	8	11	3
5	9	15.5	6.5
6	4.5	14	9.5
6	7	12.5	5.5
7	10	17	7
8	8.5	15.5	7

9	6.5	12	5.5
10	9	18	9
11	8.5	15	6.5
12	4.5	12.5	8
13	6.5	12.5	6
14	10	19.5	6.5
15	9	17.5	8.5
16	4.5	14	9.5
17	6.5	11.5	5
18	5	13	8
19	11	17	3.5
<b>Mean scores</b>	<b>7.4</b>	<b>14.5</b>	<b>7.1</b>

Table 1 illustrates the individual students' pre-test and post-test scores. The scores revealed an improvement in the performance of the students after teaching using cooperative learning strategies. In the pretest, the highest score of the student was 11 and the lowest score was 4.5 whereas the highest score of the students was 19.5 and the lowest score was 11 in the posttest. The results showed that the post-test scores were higher than the pretest scores. The mean scores of the pretest and posttest were 7.4 and 14.5, respectively, resulting in a mean difference of 7.1. This exhibited that all students improved in their learning achievement during the post-test.

**Table 2** Comparison of the pre-test and post-test: paired sample t-test

	Pre-test		Posttest		_ Mean Difference	P Value
	Mean	SD	Mean	SD		
Sample Group	7.4	3.9	14.5	4.2	14.5 - 7.4 = 7.1	0.000

Significance level (p): < 0.05

Based on the paired sample t-test in Table 2 the statistical data shows that the pre-test mean score on learning achievement was 7.4 with a standard deviation of 3.9, while the posttest mean score was 14.5 with a standard deviation of 4.2. The results of the P-value .000 shows

statistically significant gain that indicated significant increase in scores on the post-tests as compared to the pre-test. For the study to be significant the P value should be less than 0.05.

### **Students' opinion about the use of cooperative learning strategies**

Students' views about cooperative learning were collected through an open ended interview after the implementations. Only 11 students participated in the open-ended interview. Students' opinions about the use of cooperative learning strategies are presented in the table below;

**Table 3** Student's opinions about the use of cooperative learning strategies

<b>Student Number</b>	<b>Student's opinions about the use of cooperative learning strategies</b>
1	I understood the concepts better as working with friends gave me the opportunity to share my ideas.
2	The use of cooperative strategies helped me to remember the lesson for a longer duration.
4	I would love to see other subject teachers using cooperative learning strategies when teaching students because these make the lesson interesting and enjoyable.
6	I love cooperative learning strategies because these me opportunity to work with friends. Moreover, these have helped me in building confidence to learn mathematics.
7	Cooperative learning strategies have helped me to understand the difficult topics in an easier ways. It has also build my confidence in mathematics.
9	I learnt many lesson such as respecting friends, working together, helping other and being supportive in the class.
11	I enjoyed the mathematics lessons when taught using cooperative learning strategy. The use of cooperative learning strategies not only engaged me, but also helped me to develop interest in learning mathematics.
13	Cooperative learning is more fun and gives opportunity to explore with friends.
15	I learnt more when engaged with my friends as I felt comfortable learning from my peers than the teacher.
16	I enjoyed Mathematics lesson when working with friends. They encouraged me

	to work hard.
19	I would love to learn mathematics lesson from friends as it is more fun and interesting.

The above table revealed students' positive opinions about cooperative learning which includes enjoyment, building confidence, improving social skills, developing interest in learning, better understanding of concepts and learning through collaboration that lead to better performance in the subject.

### Discussions

The results of the present study justified that incorporation of cooperative learning strategies help students learn Mathematics more effectively as they provide students with an authentic environment to learn and practice in a stimulating ways. Data collected through the subject achievement of grade six students disclosed that the post-test mean score 14.5 was significantly higher than the pre-test mean score 7.4 with the mean difference of 7.1. The significance value (P) was 0.00. These findings showed that there was an increase in the learning achievement of the students in mathematics after the use of cooperative learning strategies.

The above result align with the findings of [23] who found high academic achievement and enhancement of attitude towards mathematics for those who were taught using cooperative learning methods. Similarly, [24] studied the use of cooperative learning strategies and it was found that the use of these strategies students learn mathematics, build confidence, and develop social skills along with a sense of collaboration. The finding also correlates to the studies conducted by [17] concluded that the cooperative learning method is more effective than the traditional teaching method in the academic success of students. [16] found that cooperative learning improves students' achievement in mathematics. Further, cooperative learning is an effective approach that mathematics teachers need to incorporate into their teaching.

Further, the finding from the open-ended interview reveals that the use of cooperative learning strategies during the period of teaching and learning session has positive impacts which includes enjoyment, interest in learning, better understanding of concepts and learning through collaboration that resulted in better performance in the subject. The result agrees with the earlier study conducted by [25] discovered that the use of manipulatives and

cooperative learning strategies helped students to work in groups which enhanced mathematical skills such as problem solving and developed a positive attitude towards learning. It also helped in improving student performances and developed critical and analytical thinking skills. The interviews with the students indicated a positive attitude towards learning mathematics as they stated that they enjoyed and were happy to learn mathematics using manipulatives and cooperative learning.

All the aforementioned findings disclose that the use of cooperative learning strategies facilitated in bringing improvements in the learning scores of students in mathematics.

### **Conclusion**

It can be concluded that cooperative learning strategy is an effective technique to ensure meaningful teaching and learning in mathematics. The students taught using cooperative learning strategy accomplished significantly higher than those taught with traditional teaching methods. Therefore, for better achievement, mathematics teachers should be encouraged to adopt and adapt appropriate cooperative learning strategy in combination with other aptly selected teaching methods. The use of variety of teaching methods help students' in understanding the subject better compared to conventional styles. Thus, better and higher accomplishment could be continued and the act of seeing mathematics as a difficult subject will be reduced.

### **Ethical and Consent Approval**

As per international standard or university standard written ethical approval and participants' written consent has been collected and preserved by the author(s).

### **Recommendations**

The following recommendations are made by the researchers based on the research findings:

1. Mathematics teachers should adopt and employ cooperative learning strategies in teaching different Mathematics concepts as it facilitates students' achievement mathematics.
2. It is also important for Mathematics teachers to align the teaching styles to the learning needs of the students for the effective and consistent delivery of the lessons.

### **Limitations**

The findings of this AR are limited to only the one grade level from the selected school and left out other classes which would be instructive to carry out future research. This study was carried out on a small scale and used a limited population within a short period. Therefore, its finding may not be used to generalize the impact of using cooperative learning strategies on a larger scale. The findings are limited to the grade six students of the target school only. Generalizing the findings to the rest of the learners in the schools of Bhutan may not be appropriate.

## References

- [1] Kolawole, E. B., Oladosu, C. I and Ajetumobi, O. (2013). Comparability of effectiveness of problem- solving methods on learners' performance in mathematics. *Unique Journal of Educational Research*, 1(2): 12-19.
- [2] Ochuenwike, G. N. (2014). Mathematics: A Tool for Entrepreneurship Development. *International Journal of Educational Research. Official Journal of Faculty of Education*, University of Nigeria Nsukka, 13(1): 121.
- [3] Dukpa, P. (2015). Bhutanese student's attitude towards mathematics: Findings from a cross-sectional survey of grade six students. *Attitude towards mathematics*, 16 (2), 37-52
- [4] Lham, K. (2017). *The effect of using manipulatives in teaching mathematics to enhance learning outcome of grade 5 Bhutanese students* (Unpublished Master's thesis). Rangsit University, Thailand
- [5] Royal Education Council. (2016). *National school curriculum conference*. Rethinking Curriculum. Paro, Bhutan.
- [6] Taaima, Rushdi Ahmed, and Al-Shuaibi, Muhammad Alaeddin (2006). Teaching reading and literature, a different strategy for a diverse audience. Cairo: The Arab Thought House
- [7] Maxwell T, W. (2003) Action research for Bhutan. In the Rabsel: *The CERD Educational Journal*, 3, 1–20.
- [8] Andaya, O. J. F. (2014). Factors that affect mathematics achievements of students of Philippine Normal University, Isabela Campus. *Journal of Arts, Science and Commere*, 5(4): 83.
- [9] Idris, N. (2006) Exploring the Effects of TI-84 Plus on Achievement and Anxiety in in

- Mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, 2(3)
- [10] Zakaria, E., & Iksan, Z. (2007) Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Eurasia Journal of Mathematics, Science & Technology Education*, 2007, 3(1), 35-39
- [11] Abrami, P.C., & Chambers, B. (2004). Teacher Motivation to implement an educational innovation: Factors differentiating users and non-users of cooperative learning. *Educational psychology*, 24, 201-216.
- [12] Johnson, D.E., Johnson, R.T., & Stanne, M.E. (2000). *Cooperative learning methods: Metaanalysis*, Minneapolis, MN: Univer of Minnesota Press.
- [13] Johnson, D. W., & Johnson, R. T. (2018) *Cooperative learning: The foundation for active learning*. Active Learning - Beyond the Future. [www.intechopen.com/books/active-learning-beyond-the-future/cooperative-learning-the-foundation-for-active-learning](http://www.intechopen.com/books/active-learning-beyond-the-future/cooperative-learning-the-foundation-for-active-learning)
- [14] Shimazoe, J., & Aldrich, H. (2010). Group can be gratifying: Understanding and overcoming resistance to cooperative learning. *College Teaching*, 58, 52-57. doi:10.1080/87567550903418594
- [15] Veenman, S, Benthum, N.V, Bootsma, D, Dieren, J.V. & Kemp, N.V.D (2002). Cooperative learning and teacher education. *Teaching and Teacher Education*, 18, 87-103.
- [16] Zakaria, E., Chin, L. C., & Daud, M. Y. (2010). The effects of cooperative learning on students' mathematics achievement and attitude towards mathematics. *Journal of Social Science*, 6, 272-275.
- [17] Melihan, U., & Sirri, A. (2011). The effect of cooperative learning method on the students' success and recall levels of the 8th grade students learning in permutation and probability subject. *Journal of Kirsehir Education Faculty*, 12, 1-16
- [18] Effandi, Z. (2003). *The effects of cooperative learning on students in a matriculation Mathematics class*. Ph.D thesis. Universiti Kebangsaan Malaysia, Bangi.
- [19] Vaughan, W. (2002) Effects of Cooperative Learning on Achievement and Attitude Among Students of Color, *The Journal of Educational Research*, 95(6), 359-364, doi:10.1080/00220670209596610
- [20] Heaton, R. M. (2000). *Teaching mathematics to the new standards : relearning the dance*. *The practitioner inquiry series*; Teachers College Press.

- [21] Choden, P., & Chalermnirundorn, N. (2021) The Integration of Manipulatives and Cooperative Learning in the Learning Measurement of Grade Four Bhutanese Students. *Walailak Journal of Social Science*, 14 (5)
- [22] Phuntsho, S., & Gyeltshen, T. (2022) Effectiveness of jigsaw cooperative learning approach in mathematics: A study in a middle secondary school in Bumthang district. *Interdisciplinary Journal of Applied and Basic Subjects*, 2(4), 01-10
- [23] Karali, Y., & Aydemir, H. (2018). The effect of cooperative learning on the academic achievement and attitude of students in Mathematics class. *Educational Research and Reviews*, 13(21), 712-722.
- [24] Kane, L. (2018). *Cooperative learning in math education* (Master's thesis). Illinois: Northwestern College.
- [25] Carbonneau, J. K., Wong, M. R., & Borysenko, N. (2020). The influence of perceptually rich manipulatives and collaboration on mathematics problem-solving and perseverance. *Contemporary Educational Psychology*, 61, 1-11.