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Improving Grade VII Students' Mathematics performance through Cooperative Learning Strategy: An Action Research

Author: Samten Wangchuk[1]*
Minjey Middle Secondary School, Lhuentse

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Abstract

The study examined the effectiveness of using cooperative learning strategy on seventh grade students' learning achievement in mathematics and their satisfaction level towards the subject. The study employed a quantitative approach involving experimental research design where cooperative learning was the independent variable while students' test scores and attitude towards mathematics were the dependent variables. The subjects of the study were 28 students comprising 14 boys and 14 girls respectively. Data were analyzed by calculating means, standard deviations and paired samples t-test. The results revealed a mean score of 44.6 in pre-test and 59.2 in the post-test, with a mean difference 14.6 and the significant value (p) obtained was .000. The findings indicated higher scores in the post-test, vis-a-vis the pre-test of all 28 research participants. Moreover, the students' satisfaction level analysis indicated that their attitude towards mathematics improved as shown by the increase in the level of interest, understanding and satisfaction in the subject. Therefore, it is recommended that teachers may use cooperative learning strategy to improve students' academic performance, social interaction skills and foster meta-cognition in students.

Key words: *cooperative learning g strategy, mathematics, academic performance*

Corresponding author: samwangchuk@education.gov.bt

Introduction

Mathematics is a fundamental branch of science that deals with the study of numbers, quantity, space, patterns, and relationships. It is considered the language of science and is used to describe and understand the natural world, as well as to solve various real-life problems. Mathematics is characterized by its logical and systematic approach to analyzing and deducing conclusions based on established principles and rules. Mathematics is the science that deals with the logic of shape, quantity and arrangement. Mathematics is all around us, in everything we do. It is the building block for everything in our daily lives, including mobile devices, architecture (ancient and modern), art, money, engineering and even sport (Oxford languages, 2013). Recognizing its significance, Mathematics has consistently been emphasized as a compulsory subject in Bhutanese schools. However, the academic performance of Bhutanese learners in mathematics remains lower compared to other subjects. Many students have demonstrated subpar proficiency in fundamental and advanced mathematical skills, and they also lack basic communication and analytical abilities. On average, learners needed an extra year to reach the expected competency level for their respective grade (BCSEA, 2016). The reason for low performance may vary but this could sometimes be related to the teaching method being used by the teachers to explain the mathematical concepts. Harbor-Peter (2018) asserts that the issue of poor performance in mathematics examinations was due to problem of teaching methods. There is a growing recognition among individuals involved in mathematics education that the traditional approach to teaching mathematics has not yielded significant success. For effective teaching to take place, the skillful mathematics teacher needs to use many different methods and techniques at his disposal. A carefully designed teaching method can make teaching and learning effective (Chianson, 2008). Moreover, Johnson and Johnson (2019) and Slavin and Steven (2018) emphasize that results in positive effect on students' achievement is cooperative learning.

Cooperative learning strategy is an educational approach that promotes active engagement and collaboration among students to achieve shared learning goals. In this method, students work together in small groups to solve problems, complete tasks, or achieve academic objectives. Unlike traditional teacher-centered approaches, cooperative learning emphasizes student interaction, communication, and mutual support. Trowbridge et al. (2000) defines cooperative learning as a teaching strategy that organizes students in small groups so that they can work together to maximize the learning of others. In particular, the cooperative learning method in education involves arranging students into pairs or small groups with the purpose of assisting each other in comprehending the assigned course content. Furthermore, cooperative learning involves group work among students, resulting in positive interdependence. Typically, in cooperative learning, academic assignments are structured or divided so that everyone can participate fairly and all students are responsible (Candler, 2014).

Cooperative learning activities serve as a valuable tool in pinpointing common misconceptions among students, enabling teachers and students to concentrate on specific concepts. A successful mathematics teaching approach should incorporate active engagement from students. The interactive and collaborative nature of learning in mathematics classrooms encourages educators to promote interactive learning through activities that involve student writing, reading, speaking, and teamwork. This approach empowers students to develop effective group work skills and enhances their ability to communicate about mathematical concepts both orally and in written form.

Learner-centered teaching and learning methods involve actively involving the student in the learning

process, facilitating a deeper understanding of the subject matter, and fostering a positive disposition towards the subject. To enhance academic performance, teachers should employ instructional approaches that prioritize learner-centricity, thereby encouraging imaginative, critical, and creative skills in students, resulting in better achievement of instructional objectives. Therefore, the study specifically aimed to determine the effectiveness of using cooperative learning strategies on grade seven students' learning achievement in mathematics and their attitude in terms of their level of interest, satisfaction and difficulty in learning the subject.

Research objectives

1. To examine the impact of cooperative learning strategies on the mathematics performance of Grade VII students.
2. To determine if there is a significant difference in mathematics performance of students before and after the implementation of cooperative learning strategies.
3. To assess the satisfaction level of students towards the intervention program.

Background of the study

Mathematics serves as a fundamental subject that lays the groundwork for various academic and real-life applications. However, it has been observed that there is decline in the mathematics performance of grade seven students of Minjey Middle Secondary School, Lhuentse, over the past three years. This has become a pressing issue for both teachers and the school administration. This continual drop in mathematics performance among these students has led to an increase in academic failures, causing concern and highlighting the need for effective intervention.

Thus, it is essential to assess suitable teaching and learning techniques to effectively address the mentioned issue in a timely manner. It remained uncertain whether an environment of collaboration could contribute to enhancing students' achievements in these specific areas. Further, the data also showed low standardized test scores owing to the lack of daily homework completion and the students' poor motivation in mathematics. Hence there was an urgent need to conduct a serious research based on actual classroom practices and find solutions.

Therefore, this action research investigated the effectiveness of implementing cooperative learning strategies in grade VII mathematics classrooms to enhance students' academic performance. The study also delved into the potential benefits of this approach, such as improved problem-solving abilities, increased motivation, enhanced critical thinking, and greater retention of mathematical concepts.

Literature Review

Mathematics education plays a vital role in shaping students' cognitive abilities, problem-solving skills, and analytical thinking. Over the years, educators and researchers have sought effective instructional approaches to improve students' mathematics performance. One such approach is cooperative learning, which emphasizes collaboration, active engagement, and peer interaction. This literature review aims to explore the relationship between cooperative learning strategy and students' mathematics performance.

Cooperative learning strategy is an educational approach that promotes active engagement and

collaboration among students to achieve shared learning goals. In this method, students work together in small groups to solve problems, complete tasks, or achieve academic objectives. Unlike traditional teacher-centered approaches, cooperative learning emphasizes student interaction, communication, and mutual support. Abrami and Chambers (2004) 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. Johnson (2000) 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 has been demonstrated in countless studies and several meta-analyses. Similarly, Kagan (1989) defined CL as a teaching arrangement that refers to small, heterogeneous groups of students working together to achieve a common goal. A common feature in the above definitions is that students work in small groups to achieve a common goal.

Numerous studies have investigated the impact of cooperative learning on mathematics achievement. Johnson and Johnson (1999) conducted a meta-analysis of 164 studies and found that cooperative learning had a significant positive effect on students' mathematics performance. The collaborative nature of the strategy allowed students to clarify concepts, share diverse perspectives, and support each other's learning, leading to improved academic outcomes. Similarly, Cooperative learning has been shown to enhance students' conceptual understanding of mathematical concepts. Casey, and Fernandez-Rio (2019) noted that through the cooperative method, students learned to value both their own and others' views and solutions, become highly self-reliant on their own minds and ideas, adapt peer group work to suit their own and others' needs within the classroom, and think of academic success and achievement in terms of contribution than just performance in exams. They also noted an increase in positivity especially self-esteem and motivation in their work.

Cooperative learning promotes problem-solving skills among students. In their study Hasanah, and Surya (2017) concluded that learning through cooperative method increased student achievement and improved student creative thinking in mathematics problem solving hence a suitable method for mathematics instruction. Likewise, Zhang (2010) in his article argues that cooperative learning not only increases productivity and a higher academic success rate but also provides a higher chance for communication among the learners.

Juweto (2015), examined the effect of CL method on students' achievement and attitude towards biology in secondary schools in Delta State in the United States of America and concluded that CL method increased students' achievement and promoted positive attitude towards studying biology. Additionally, Slavin (2011) argues in his paper that in a world of social media and technology, we need a method of learning that promotes social interactions and engagement hence the need for cooperative learning because it is the practical way of promoting these social interactions and communication. They continue to acknowledge that previous studies have observed that the implementation of cooperative learning continues to be informal and does not follow the required procedure despite hundreds of studies finding it as an alternative to traditional methods.

Research suggests that cooperative learning positively affects students' motivation in mathematics. Lou et al. (2018) conducted a study with elementary students and found that cooperative learning activities increased students' interest and enthusiasm for mathematics. The sense of belonging to a supportive learning community and the opportunity to contribute to group success enhanced students' engagement and persistence in the subject. Further, Ugwuadu and Abdullahi

(2012) attribute to CL method facilitating better conceptual understand of the subject matter as students share ideas and point of views, give and receive support from each member who helps to dig below the superficial level of understanding of the material they learn. Similarly, Zakaria, Chin, and Daud (2010) concluded in their study that student-centered approaches to learning such as cooperative learning increased student motivation and achievement in mathematics and encouraged teachers to implement such methods in their instruction techniques to allow students to help each other. They also encouraged the employment of STAD, a cooperative learning technique in mathematics instruction to achieve a higher achievement and attitude towards mathematics.

The literature review demonstrates that cooperative learning strategy is a powerful approach to enhance students' mathematics performance. Through collaboration, active engagement, and peer interaction, students can develop a deeper conceptual understanding, improve problem-solving skills, and increase motivation in mathematics. The positive impact of cooperative learning extends to addressing individual differences, making it a promising pedagogical approach for improving mathematics education. A common theme throughout the literature reflects that as students work in cooperative groups, they gain a deeper understanding of concepts.

There is plenty of literature on the effectiveness of cooperative learning strategies on students' learning achievement and attitude. However, literature review has not revealed any studies on the effectiveness of cooperative learning approach on students' mathematics achievement scores and attitude towards the subject in Bhutan. Therefore, this study attempts to fill this knowledge gap and contribute to the body of knowledge on cooperative learning approach.

Overarching research question

How can I improve mathematics performance of class seven students using cooperative learning strategies?

Sub-questions

1. What is the satisfaction level of students towards cooperative learning strategies after the intervention?
2. Is there a significant difference between pre-test and post-test scores of grade seven students?
3. How can the use of cooperative learning strategies in mathematics impact students' performance?

Research Methodology

The teacher researcher adopted a quantitative research approach involving quasi-experimental research design to investigate the effectiveness of cooperative learning strategy in enhancing mathematics performance and used survey questionnaires to find out students' satisfaction level towards intervention program.

Sample

The study used a convenience sampling technique. The total sample size comprised of 28 students consisting 14 boys and 14 girls of Minjey Middle Secondary School, Lhuentse, Bhutan.

Research Instrument

The following instruments were used in collecting data.

Performance Tests

The performance tests were classified into two categories – pre- and post-test respectively. The tests for 20 marks were administered to the sample group that could be answered in an hour. The test items were purely based on the concept/content that was taught.

Pre- test

The objective for implementing pre-test was to determine the level of competency that the student possessed prior to implementation of the intervention program. It was conducted before the start of the program with the sample group.

Post- test

Similarly, the objective of administering post-test was to investigate students' level of performance in the subject after participating into five weeks interventions in term of learning outcomes.

Satisfaction Questionnaire

A 5-points Likert scale questionnaire was developed and administered to investigate students' attitude/satisfaction level towards intervention program. It was surveyed with sample group. The data collected from the questionnaire was analyzed in terms of mean scores and standard deviations to determine the satisfaction level towards the program.

Significance of the study

This study explored the effectiveness of cooperative learning strategy in enhancing grade seven students' mathematics performance. The study has the following significance;

1. It has contributed to the existing body of knowledge on cooperative learning and also provide valuable insights for mathematics teachers, school administrators, and policymakers.
2. Enlightened instructional practices and curriculum development, encouraging the adoption of student-centered approaches that foster a positive learning environment and boost mathematics performance
3. The study has supported the overall improvement of mathematics education and contribute to students' academic success and lifelong learning skills.

Intervention phase and implementation

The intervention phase of this action research project focused on implementing cooperative learning strategies to enhance the mathematics performance of Grade VII students. This phase involved the practical application of the selected strategies within the classroom setting. The intervention period spanned for five weeks and provided ample time for students to engage in cooperative learning activities, practice, and experience the potential benefits. The teacher researcher selected specific cooperative learning strategies, such as group investigation, peer teaching, jigsaw, number heads together, think pair share, round table and corners aligning with the mathematics curriculum. Further, students were divided into small, diverse groups, taking into consideration their mathematical abilities. These groups remained consistent throughout the intervention phase.

During regular mathematics classes, selected cooperative learning strategies were applied. The teacher facilitated and guided students as they work together on math problems, projects, or tasks. At the end of the five-week period, students were assessed on the concept/ content taught to see the overall impact of the cooperative learning intervention on their mathematics performance.

Result and findings

Table 1 **Pre-test and Post-test scores of individual students in mathematic test**

Student No	Pre-test (20)	Post-test (20)
1	7	13
2	2.5	6.5
3	7.5	9.5
4	3	6.5
5	9	13.5
6	17	18.5
7	8.5	10.5
8	5	6
9	11	12
10	3.5	7
11	13	15
12	16	16.5
13	4.5	15
14	5	8
15	8	12.5
16	14.5	16
17	4.5	8.5
18	10	13
19	8	11.5
20	3	6
21	8	10.5
22	12	15.5
23	15.5	17.5
24	8	10.5
25	18	17.5
26	8.5	12
27	9.5	13
28	9.5	10

Class test was conducted to measure the academic achievements of the learners. Test was conducted twice, one at the beginning and second after the application of intervention; the tests had a total score of 20. The test questions constituted three parts comprising five marks multiple choice in part I; 5 marks short question answer in part II and 10 marks in part III (extended questions). The above table reveals the pre-test and post-test scores of the sample group. The individual student's post-test scores discloses that their performance in mathematics has improved. The individual pre-test scores ranged from 2.5 to 17, while the post-test scores ranged from 6 to 17.5, indicating a significant improvement in the post-test scores.

Table 2 Comparison of pre-test and post-test score of sample group

Group	Pre-test	Post-test	Mean difference	P value
	Mean	Mean		
Sample Group	SD 44.6 10.2	SD 59.2 8.7	14.6	**.000**

The Table 2 reveals the score of pre-test and post-test of the sample group. The pre-test mean was 44.6, with a standard deviation of 10.2. The post-test mean score was 59.2 with 8.7 standard deviation. The mean difference between the pre-test and the post-test was 14.6, showing an increase in the mean score of the post-test. Furthermore, the significance value, which stands at .000 and is below the 0.05 ($P<0.05$), which signifies a statistically significant improvement in post-test scores compared to the pre-test scores within the sample group.

Table 3 Summary of students' satisfaction in term of three classified factors

	Least satisfaction	Low satisfaction	Moderate satisfaction	High satisfaction	Highest satisfaction	Total
Interest	3.6	2.8	17.7	48.1	27.8	100
Participation	4.8	1.2	22.5	38.9	32.6	100
Satisfaction	1.6	2.5	18.8	46.4	30.7	100

The comprehensive analysis of the responses obtained from the survey questionnaire indicates that the participants exhibited a high level of satisfaction across all categorized factors. As illustrated in Table 2, a significant portion of learners, specifically 48.1%, expressed "High Satisfaction" with regard to their interest in learning mathematics through the cooperative learning strategy. Furthermore, 38.9% of the participants conveyed their "High Satisfaction" in the classroom participation aspect, emphasizing that this approach motivated them to actively engage in learning activities through frequent group interactions. Additionally, 46.4% of the respondents indicated their "High Satisfaction" in learning the subject's concepts through the cooperative learning method, which encompassed multiple intelligences (MI) activities catering to diverse needs of the learners. Thus, it can be inferred that students exhibited a high level of satisfaction and a positive attitude toward the cooperative learning strategy employed in mathematics education.

Discussion

The study investigated the effectiveness of cooperative learning strategies in enhancing grade VII students' mathematics performance. The results of the study clearly indicate a significant positive impact of cooperative learning strategies on students' mathematics performance. The post-test scores

showed a substantial improvement, with a mean difference of 14.6 between pre-test and post-test scores. This statistically significant increase in performance demonstrates that cooperative learning positively affects students' understanding of mathematical concepts. The finding was consistent with Kwon and Bang (2019) conducted a study with middle school students and observed that those engaged in cooperative learning activities demonstrated a deeper understanding of mathematical concepts compared to students in traditional classrooms. The active discussions and peer interactions allowed students to construct meaning and grasp complex mathematical ideas effectively. The finding was also congruent with the findings of Armstrong et al (2007) with the study that compared CL approach and traditional lecture method in an undergraduate course reported that the experimental group that was instructed through CL approach showed greater improvement in overall test scores than control group that was taught using a traditional lecture approach. He further noted that the experimental group performed significantly better on questions requiring both factual knowledge and comprehension than students in the control group who were instructed through the regular lecture format.

The survey questionnaire results showed that students had a high level of satisfaction with the cooperative learning strategy. The majority of students expressed "High Satisfaction" levels in various aspects, including interest, classroom participation, and satisfaction with the subject. This suggests that students found the cooperative learning approach engaging and enjoyable. This finding corresponds with the result of Lou et al. (2018) who conducted a study with elementary students and observed that cooperative learning activities increased students' interest enthusiasm and satisfaction level for mathematics. The sense of belonging to a supportive learning community and the opportunity to contribute to group success enhanced students' engagement and persistence in the subject. Similarly, the findings of Hasanah and Surya (2017) support the result, who concluded that learning through cooperative method increased student achievement and improved student creative thinking in mathematics problem solving hence a suitable method for mathematics instruction.

The study further justified that cooperative learning strategies encouraged collaboration among students. The study incorporated diverse groups of students who worked together to solve problems, fostering peer interaction and communication. This collaborative approach enhances teamwork and communication skills, which are vital for academic success and real-life applications. The result was supported by the findings of Tran (2019) argues that cooperative learning increased the motivation of 72 Vietnamese students in their findings. Frequent collaboration and team-work among the students promoted effective learning hence a higher learning outcome was observed. The cooperative learning method has been proposed by many stakeholders as an alternative to the traditional methods but still requires more research and studies to confirm its effectiveness in pedagogy.

Conclusion

The results of the study showed that grade seven students performed better in mathematics after using cooperative learning instructional strategy irrespective of their ability level than those students using traditional method. This approach not only improved academic outcomes but also fostered student engagement, team work, motivation, peer interaction and problem-solving abilities thereby. Further, the study's findings underscore the potential of cooperative learning strategy as a valuable pedagogical tool for mathematics teachers seeking to enhance their teaching methods and contribute

to students' overall success in mathematics. This research contributes to the existing body of knowledge on cooperative learning and serves as a foundation for further exploration and implementation of this approach in mathematics curriculum delivery.

Recommendation

Since cooperative learning was found to be more effective in the teaching and learning of mathematics curriculum, mathematics teachers are recommended to adopt the cooperative learning strategy in order to improve students' academic performance, social interaction skills and foster meta-cognition in students. Workshops should be organized by relevant agencies to emphasize and enlighten teachers and mathematics educators on the importance of the cooperative learning approach. Further, additional research may be conducted on large sample size to increase the generalizability of the finding to the subject of education and also future research should focus on comparisons between different models of cooperative learning.

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