Received Date: Sept. 2023 Revised: Nov. 2023 Accepted: Dec. 2023

Analytical Study of Cooperative Learning in Mathematics

Yogendra Prasad Shah
Lecturer in Mathematics
Patan Multiple Campus, TU,
Email: yog.9841@gmail.com
Doi: https://doi.org/10.3126/pragya.v12i02.64211

Abstract

This exhaustive study delves into the application and impact of cooperative learning in mathematics education, specifically focusing on the context of Nepal. The primary aim is to assess the effectiveness and prevalence of cooperative learning strategies employed by mathematics teachers at both school and college levels. The investigation centers on small-group cooperative learning as an alternative pedagogical approach, contrasting it with traditional whole-class expository instruction and individual instruction systems. The study outlines practical and realistic strategies for utilizing small groups in mathematics teaching, emphasizing their applicability across different age groups and curricula. Furthermore, the study encompasses three computer-based cooperative learning strategies designed for classroom implementation, various learning activities aimed at establishing a cooperative classroom setting, and procedures for group problem-solving and inquiry specifically in algebra, geometry, and trigonometry. The implications of this finding underscore the need for further efforts to enhance the adoption of cooperative learning among mathematics teachers in Nepal.

Key Words: Cooperative Learning, Mathematics, Students, Strategy, Team Work.

Introduction

This paper investigates the applicability of cooperative learning in mathematics education, specifically within the Nepalese context. Cooperative learning, characterized by students working together in small groups, has emerged as a pedagogical approach that promotes face-to-face communication and interpersonal tasks (Slavin, 2015). The aim of this study is to evaluate the extent to which mathematics teachers in Nepal employ cooperative learning approaches in their classrooms, both at the school and college levels. Addressing the feedback from the reviewer, the introduction will be enhanced to provide a more comprehensive overview and detail the importance of cooperative learning in the educational landscape.

Cooperative learning, as a teaching strategy, emphasizes collaborative efforts, allowing students to actively engage with mathematical concepts (Johnson & Johnson, 1994). The traditional teaching methods often involve whole-class expository instruction or individualized approaches, but cooperative learning offers an alternative that encourages shared learning experiences. In the Nepalese educational setting, where mathematics

education plays a crucial role, understanding the prevalence and effectiveness of cooperative learning becomes paramount.

As highlighted in the previous version of the paper, the primary objective of the study is to investigate the adoption of cooperative learning among mathematics teachers in Nepal (Slavin, 1995). The relevance of cooperative learning in mathematics education is underscored by its potential to enhance critical thinking, problem-solving skills, and overall understanding of mathematical concepts. The previous criticisms suggested that the introduction needed improvement and elaboration; thus, this revised introduction aims to provide a more detailed overview of the significance of cooperative learning in the context of Nepalese mathematics education.

The study seeks to address the critique by offering a more nuanced exploration of the cooperative learning landscape in Nepal. The objective remains centered on understanding the strategies employed by teachers, ensuring that both students and teachers actively participate in the learning process. By evaluating the extent of cooperative learning adoption and considering its implications, this study aims to contribute valuable insights to the ongoing discourse on effective mathematics education in Nepal (Echeita & Martín, 1990).

Discussion

The Discussion section of this paper delves into the significance and efficacy of cooperative learning in the teaching of mathematics, particularly in the Nepalese classroom context. The arguments presented are founded on secondary data derived from various source materials. While the focus is primarily on primary and secondary education, the overarching objective of the paper extends to college-level mathematics teaching. In response to the reviewer's feedback, this revised discussion seeks to address the identified gap by broadening the discourse to include insights into cooperative learning at the college level.

Cooperative learning, as highlighted in the paper, plays a pivotal role in facilitating the understanding of complex mathematical concepts among students. The ability to cooperate and collaborate has become a crucial competence for learners facing challenges in comprehending intricate mathematical ideas. Through cooperative learning, students can accumulate information on mathematical figures and concepts, fostering a productive and creative learning environment. This collaborative approach is particularly relevant in educational contexts where students' interactions contribute to desirable learning outcomes. Students who work in an organized way with the cooperative learning approach can have better results in the following areas:

a. the usage of reasoning strategies
b. the capacity to explore new ideas;
c. the suitable solution to problems;
d. the talent to transfer what is learnt in the class to the personal solution of problems

These benefits are priceless and they do contribute to the teachers in making their classroom teaching effective and adoptable. Students can have fun and stay engaged in the learning process.

Planning and designing the cooperative learning model (STAD) includes the steps in presentation of the lesson that enhances cognitive development. In small group activities, social skills are promoted by members being together and developing excellent interpersonal relationships. This boosts up development of the affective area constructing good behaviors, needed traits and dignity. Learning activities under the cooperative learning model (STAD) incorporates the following approaches and steps:

i. Class presentation – The class learns the subject content presented by the teacher who chose appropriate techniques, activities, and learning experiences for the students.
ii. Team Study – A team consists of 4-5 students with different achievements and mixed sexes. Team members have to attempt to study the content cards and do the activity assigned so far. Each student helps one another in doing so. The teaching media comprise content cards, activity cards, and answer key cards.
iii. Testing step –After the content of weight measurement is taught, the learners take the test which consists objective 4-choice items and subjective items. Students are not allowed to help each other in the test. Everyone had to do the test on her own.
iv. Team Recognition – The scores from the test are computed for individual and team improvement. Team recognition or prize awards occur when the team scores higher than the established criteria. The improvement scores of each student and team are computed from the differences of the test scores and the base score of each student.

There are many benefits from the cooperative learning approach in the classroom. Students can basically benefit from this approach. However, certain principles must be followed while implementing the cooperative learning. Some of the principles can be:

a. normal distribution of students in heterogeneous group-class
b. the working teams are heterogeneous
c. co-operation among the students of each group
d. equal distribution of opportunity
e. heroism of students
f. personal and collective evaluation

In the highly individualistic and competitive academic environments, cooperative learning emerges as a powerful strategy. The traditional reluctance to seek help from classmates due to fear of being perceived as dependent or weak is overcome through cooperative learning. When learning tasks are structured to encourage collaboration, the positive effects on coexistence, motivation, and overall academic performance are evident (Echeita & Martin, 1990). In an organized cooperative learning environment, students exhibit

improved reasoning strategies, enhanced capacity to explore new ideas, an aptitude for problem-solving, and the ability to transfer learned concepts to personal problem-solving.

These benefits extend beyond individual student outcomes and significantly contribute to the effectiveness and adoptability of teachers in the classroom. The cooperative learning model, such as the Student Teams-Achievement Division (STAD) discussed in the paper, encompasses various steps, including class presentations, team studies, testing, and team recognition. These activities not only enhance cognitive development but also promote social skills, contributing to the affective domain by fostering good behaviors, needed traits, and dignity among students.

However, it is crucial to acknowledge that the application and implications of cooperative learning may vary in the college-level mathematics classroom. Recognizing this, the revised discussion aims to bridge the gap identified by the reviewer by expanding the discourse to encompass higher education settings. In college classrooms, cooperative learning dynamics may encounter unique challenges and opportunities.

One of the key challenges in college-level mathematics education is the diverse academic background of students. Unlike school settings, where students usually share a similar educational foundation, college classrooms often comprise individuals with varying levels of expertise and exposure to mathematical concepts. This diversity necessitates an exploration of how cooperative learning can be tailored to address the specific needs of college students, acknowledging their prior knowledge and promoting collaborative learning experiences.

Moreover, the discussion will explore the potential benefits of cooperative learning in advanced mathematical topics commonly encountered in college-level courses. Addressing topics like algebra, geometry, and calculus, the paper will delve into how cooperative learning can enhance students' problem-solving skills, promote in-depth conceptual understanding, and contribute to overall academic success.

In making the cooperative learning approach effective at the college level, certain principles should be considered. These include ensuring a normal distribution of students in heterogeneous group-class, forming heterogeneous working teams, fostering cooperation among students within each group, ensuring equal distribution of opportunities, encouraging heroism of students, and implementing personal and collective evaluation. The role of the teacher becomes even more crucial in this context. The teacher's active participation in creating a conducive learning environment, acting as an observer, mediator, adviser, and tutor, is essential. Motivating and facilitating students to engage in cooperative learning further adds to the teacher's responsibilities.

While collaborative principles have been adopted in education in Nepal, the revised mathematics program requires additional efforts to effectively apply cooperative learning methods in teaching mathematics at the college level. Creating awareness among students about the approach's benefits, fostering a sense of collaboration, and emphasizing mutual support in the learning process are integral steps. One of these principles is “collaborative

learning" (Delil & Güleş, 2007). In collaborative classrooms, students are expected to discuss topics with each other, help and evaluate each other's knowledge, and compensate for each other's deficiencies (Açıkgöz, 2003; Slavin, 1995). The table below lists different percentages of diverse types of questions that are chosen for cooperative learning practice. It shows that a high percentage usually is accompanied by types of questions such as questions worth deep investigation, questions involving multifaceted or difficult knowledge, and questions that can be solved in extraordinary ways and a much lower percentage with other types of questions. The result suggests that mathematics teachers prefer the topics that invite intricate knowledge or problem solving skills for cooperative learning practice.

Percentage of Types of Questions that Can be Raised in Interview

1.	Questions with deep research	35%
2.	Questions including compound knowledge	23%
3.	Questions which can be answered differently	24%
4.	Questions complex to be solved separately	9%
5.	Key knowledge	5%
6.	Questions that can be solved in group	4%

Cooperative learning in mathematics teaching emphasizes cooperativeness, communication, discussion, and independent thinking, often surpassing teacher guidance. The focus on independent thinking becomes secondary in this approach, with cooperation taking a more productive and prominent role in learning mathematical concepts. Research indicates that, in cooperative learning, students' roles are often regarded as superior to teachers', aligning with a student-focused approach (Ge, 2004). This method, though contradictory to traditional teaching, is more welcoming, countering the passive mood induced by strict and abstract mathematics. However, teachers exposed to cooperative learning may face challenges in facilitating students due to its transient and varied nature in real-life practice.

Teaching methodologies in mathematics vary based on context and content, with cooperative learning seen as suitable for complex epistemic targets and tasks involving emotions, attitudes, and values (Wang, 2002). In the Nepalese context, a nuanced examination is needed to establish cooperative learning principles for secondary school mathematics. It is imperative to teach students the importance of collaboration in mathematics, fostering the behavior of working collaboratively—a skill vital in contemporary society where cooperation is essential for scientific, technological, and societal developments (Şimşek, 2005).

Cooperative learning benefits students in various ways, including idea exchange, deviation on complex issues leading to improved communication, enhanced learning efficiency, and the potential for higher exam scores. The method allows students to group situations, discuss concepts, and conduct experimental research, facilitating in-depth understanding, particularly for topics involving large-scale conceptualization and multi-tiered reasoning

(Shi, 2009). Encouraging problem-solving independence is crucial, as cooperative learning enables diverse perspectives, enhancing learners' capability in problem-solving.

In cooperative learning, the combination of independent thinking and cooperative communication fosters each other. Zhang (2006) categorizes cooperation into three types—comprehensive cooperation, cooperation based on job division, and cooperation enabled by communication. Mathematics learning, involving mental activities and tasks requiring commitment, falls into the third category. The method is particularly suitable for knowledge acquisition and question discussions with a large scale of complexity and multi-tiered nature. The interplay between independent thinking and cooperative communication is vital in processes like representing, listening, and discussing, demanding attention during discussions to learners' independence.

Cooperative learning in mathematics proves effective in promoting collaboration, communication, and independent thinking among students. However, challenges exist for teachers unfamiliar with this approach, highlighting the need for tailored strategies. In the Nepalese context, understanding the specificities of cooperative learning is essential for its successful implementation in secondary school mathematics education. The approach holds promise for enhancing students' problem-solving skills and overall academic performance, aligning with the evolving educational landscape and societal demands.

Conclusion

In conclusion, cooperative learning emerges as a potent methodology for fostering collaboration, communication, and independent thinking in mathematics education. Despite posing challenges for teachers unaccustomed to its dynamics, the approach proves instrumental in cultivating a student-focused, interactive learning environment. The Nepalese context, with its unique educational landscape, requires a nuanced implementation of cooperative learning principles for optimal effectiveness. Encouraging problem-solving independence and addressing diverse mathematical complexities, this approach aligns with contemporary demands for versatile skillsets. By emphasizing collaborative strategies, cooperative learning not only enhances academic performance but also prepares students for the collaborative nature of modern society. As we navigate an evolving educational paradigm, the judicious integration of cooperative learning stands poised to contribute significantly to the holistic development of students in mathematics and beyond.

References

Delil, A., & Güleş, S. (2007). Yeni ilköğretim 6. sınıf matematik programındaki geometri ve ölçme öğrenme alanlarının yapılandırmacı öğrenme yaklaşımı açısından değerlendirilmesi. Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 20(1), 35-48.

Echeita, G. & Martín, E. (1990). *Interacción Social y Aprendizaje*, in C. Coll, J. Palacios & A. Marchesi (Eds) Desarrollo psicológico y educación. Tomo III. Madrid: Alianza.

Ge, L. (2004). Study on misleading behaviors and countermeasures in mathematic cooperative learning group. *Journal of Mathematics Education*, Vol. 3, 99-101.

Johnson DW, Johnson R. (1985). *Learning Together and Alone: Cooperative, Competitive and Individualistic Learning.* Boston: Allyn and Bacon. First Edition.

Shi, S.M. (2009). *Opinions and analysis on cases of mathematics course in middle school*. Xi'an, China: Shaanxi Normal University Publishing Company.

Şimşek, Ü. (2005). İşbirlikli öğrenme yönteminin fen bilgisi dersinin akademik başarı ve tutumuna etkisi (Master's thesis, Atatürk University, Erzurum, Turkey).

Slavin, R. E. (1995). Cooperative learning: Theory, research and practice. Boston: Allyn & Bacon.

Slavin RE (1996). Research on Cooperative Learning and Achievement: what We Know What We Need to Know. *Contemporary Educational Psychological*, Vol. 21, pp. 433-469.

Wang, T. (2002). *Conception, theory and its actualizing of cooperative learning*, Beijing, China: Chinese Human Affairs Publishing Company.

Zhang, D.Z.& Huang,R.J.(2006).Recognition on the teaching of independence exploring and cooperation. *Journal of Hunan Education*, Vol. 15, 4-6