Collaborative Learning in Mathematics: Impact on Grade 7 Students' Performance

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DOI: https://doi.org/10.47772/IJRISS.2026.10200002

Received: 03 February 2026; Accepted: 09 February 2026; Published: 21 February 2026

ABSTRACT

This study explored the impact of collaborative learning strategies on the academic performance of Grade 7 students in mathematics. It examined students' profiles in terms of age and gender, as well as pre-test and post-test performance, identified strategies influencing academic outcomes, assessed changes in performance, analyzed the relationship between collaborative learning and academic success, and gathered student perceptions on these methods. Using a quantitative quasi-experimental design, the research measured students' performance before and after implementing collaborative strategies such as Think-Pair-Share, Jigsaw, and Group Work. The findings revealed a significant improvement in mathematics performance following collaborative learning techniques. Statistical analysis confirmed a strong relationship between these strategies and academic success. The study also suggested further research on various collaborative learning approaches across different subjects, teacher training programs to enhance implementation, and broader studies to validate these findings.

Keywords: Academic Performance, Collaborative Learning, Grade 7 Students, Mathematics Education, Quasi-experimental Design.

INTRODUCTION

Mathematics is often perceived as a subject focused on abstract rules and processes [1]. In many classrooms, students learn math primarily to prepare for the next topic, the next grade level, or future academic challenges. This traditional approach emphasizes calculation speed and accuracy, such as memorizing multiplication tables, as indicators of mathematical ability [2]. Many students also consider mathematics one of the most neutral subjects in school, unaffected by social or political influences.

However, learning mathematics goes beyond calculations. How mathematics is taught and understood influences students' sense of the world. Teaching methods, accessibility, and student engagement are crucial in shaping mathematical understanding [3]. Research highlights the importance of teacher-student interactions in fostering effective learning environments. Interactive learning tools and collaborative strategies have been shown to improve creative thinking and engagement among students. Collaboration in learning has been found to activate unique cognitive processes that individual learning does not [4]. Through peer discussions and teamwork, students become more engaged, motivated, and capable of deeper learning. Cooperative learning strategies enhance problem-solving abilities, critical thinking, and academic performance. In addition, studies suggest that collaborative learning improves students' self-confidence, social skills, and motivation [5]. However, effective collaboration requires structured group interactions and tasks that promote meaningful engagement.

While numerous studies highlight the benefits of collaborative learning, limited research exists on its specific impact on students' understanding of mathematical concepts and problem-solving skills. Furthermore, there is a need to examine how collaborative learning influences the academic performance of Grade 7 students in the Philippine educational context. This study aimed to investigate the impact of collaborative learning on students' understanding of mathematical concepts and its effect on their academic performance. By examining the experiences of Grade 7 students at a Philippine school, this research bought to determine whether collaborative learning strategies enhance mathematical comprehension and contribute to improved learning outcomes. The

findings of this study provided valuable insights for educators in designing more effective teaching methods to support student success in mathematics.

Research Hypotheses

Ha: There is no significant difference between pretest and post test scores on collaborative learning in mathematics towards their academic performance among grade 7 students of Philippine Advent College.

Ho: There is a significant difference between pretest and post test scores on collaborative learning in mathematics towards their academic performance among grade 7 students of Philippine Advent College.

LITERATURE REVIEW

This portion presented the related literature and studies both worldwide and local that are closely related to the research topic. Some have also supported and reinforced the research investigation of how collaborative learning is very useful in teaching mathematics and what would be the impact of this way of teaching in terms of students' academic performance.

Collaborative learning

Collaborative learning (CL) is a teaching philosophy, collaborative learning significantly improved math scores and effectively addressed grade-specific learning objectives, Eurasia Journal of Mathematics, Science and Technology Education (2024). Collaborative way of learning is very important as it has the biggest impact to the learner's achievement among mathematics students. It is relevant to use collaborative learning in teaching mathematics as the learner's output is too much improved in terms of math scores and the effectiveness of specific grade learning outcomes. Meaning, that the use of a collaborative learning strategy in teaching mathematics is very useful to students' learning as it has an impact on students, academic performance development. Collaborative learning is characterized as the division of students into different performance classes, such as high, medium, and low performers [6]. It said that collaborative learning is the proportion of students either big or small group to do their tasks given. This way of learning strategy helps the students to express their ideas and opinions to their peers as they are doing their performance tasks. It ensures that learning is in a comfortable atmosphere for them to be more motivated. Each member in the group is responsible for his or her work as well as the work of the group, and therefore the group's work does not succeed. It states that each member of the group is reliable for his or her output as well as the performance of the group. This strategy is one of the process that the students learn on how to work hand in hand with their goals of improvements and development about their educational perception and it helps to the students on their communication skills.

Think- Pair Share

The social constructivist believes that knowledge is generated via the communication between learners and their environment and that learning is a collaborative process. This method of collaborative process helps the students to enhance their learning through their peers as they are comfortable with their partners to share knowledge and ask also on what they have confused. It helps also the learners to boost their learning through understanding via questioning inquiry and interaction. The biggest thing that think-pair share collaborative strategy helps the students to transform themselves from being a listener into a performer, from being extrovert into introvert and other significant of this collaborative process is to enhance their skills in terms of leadership.

According to [7], Think-Pair-Share Strategy is a learner-centered teaching and learning model/strategy developed. This strategy enhanced and allows the own thinking and team working as presentation of the group activity. It says that using this strategy of collaborative learning can help the students to learn by their own ability as they experience with a team. Instead of teacher centered learning it turns to learners centered learning. Active learning, in which students work out problems, riposte questions, construct questions of their own, elaborate, expand, discourse, or brainstorming activity during class.

The think–pair–share model is very suitable to be applied in Civics learning. This is based on the learning syntax with think– pair–share based on cooperative learning and active learning so it is very suitable for developing moral values of unity and nationality which are the main characteristics of Civics learning [8]. He proved oh

his study that this strategy of a collaborative learning in teaching mathematics can help students to improve their ability skills and can help to each of them by having good scores in math as well. It helps also to reach the goal of their learning outcomes.

Jigsaw

The Jigsaw Technique is a student-friendly cooperative learning methodology. The jigsaw as a community learning strategy has a significant effect on students' social attitudes, [9]. The students' gregarious perspective such as discipline, teamwork, tolerance, and self-assurance in the experimental group are higher than the control group and prove that the application of cooperative learning strategies can reduce the character of individualism and form harmony between students.

The use of the Jigsaw learning approach in teaching results in better students' performance in mathematics and those students who are positively about jigsaw approach will lead to a better learning in concepts of mathematics. It was found that the used of this approach in teaching would become more meaningful in teaching-learning process. Moreover, his study offers concrete proof to the field of education and enhances the standards of mathematics education for upcoming generations.

The teaching of literature using jigsaw enhanced students' attitudes towards collaborative learning [10]. This means that literature teachers, settings should consider adopting the jigsaw as a collaborative learning approach to better understand its efficacy. Given that learning is centered on engagement with peers, students actively engage in the learning process, leading to the enhancement of interpersonal and collaborative skills among the learners.

Group works

Collaborative learning strategy shows the importance of this by revealing the cognitive benefits students will get from studying together. It gives a lot of impact to the students for their aim to gain high scores on their activity as they undergo for a group works learning specifically to those students who are enrolled in an online class that are lack of student-to-student interaction. They are given a chance to collaborate and having their peer discussion on a task given. Also, group works can strengthen the relationship between students thru their group activity discussion.

In addition, group work and study groups are ubiquitous in higher education and have been shown to benefit students in terms of their performance and learning [11]. When dealing with the complex and sophisticated problems facing many learners, the shared and complementary skills and knowledge of a group may be beneficial in processing information, and increasing students' feelings of emotional support while learning may help overcome some issues of information processing.

Prior study has proven that group works collaborative learning strategy is more helpful as they learn by their own. The self-explanation principle claims that when students teach themselves something, it may enhance their own levels of germane load for that particular unit of information. This principle is relevance to this method of teaching as they perform a group work performance task when they working together, it might be helpful to make them more creativity and always making new ideas to share with their peers.

METHODS

This part of the research presented the methodologies that were used and utilized during the conduct of this research. The methodology consisted of the methods such as the research design, the research setting, the subject of the study, the data gathering procedure, the research instruments, the sampling design, ethical consideration, s employed in the study.

Research Design

This study employed a quantitative, quasi-experimental research design, a widely recognized approach within quantitative research. This method collects, analyzes, interprets, and presents the study results, allowing the researchers to examine multiple variables numerically and systematically. The study aimed to determine the

impact of collaborative learning on the effectiveness of teaching mathematical methods and strategies. The study measured and analyzed the collected data through statistical analysis, graphical representations, tables, and charts to comprehensively understand the subject matter.

Research Participants

This study's participants were Grade 7 students from a selected college in the Philippines. A purposive sampling technique was employed to ensure that the sample accurately represents the target population. This method allowed the researchers to deliberately select participants based on specific criteria relevant to the study. The purposive sampling approach enhanced the reliability of the findings and ensured that the collected data aligned with the study's objectives.

Research Instrument

The primary instrument for data collection in this study was a researcher-developed questionnaire. Before its implementation, the questionnaire underwent pilot testing to ensure its validity and reliability. Additionally, approval was sought from the panel members to confirm its suitability for the study. The questionnaire consisted of two sections: the first section gathers demographic information about the respondents, where participants will select responses by marking the appropriate option. The second section is a checklist that allowed respondents to indicate their perspectives on various strategies applied during the conduct of mathematics classes. This structured approach ensures a systematic collection of relevant data.

Data Gathering Procedure

Before data collection, the researchers obtained formal permission from the school principal to conduct the study. Additionally, consent was secured from the Education Coordinator to ensure the study was conducted under appropriate supervision. To create a conducive environment for data collection, the researchers identified a suitable area where participants could comfortably and freely respond to the questionnaire without external distractions. Upon distributing the questionnaire, the researchers provided clear guidelines and instructions to the participants, addressing any clarifications or difficulties they might encounter. To minimize bias, the respondents completed the questionnaire independently without interference from the researchers.

Ethical Considerations

This study adhered to the six ethical considerations outlined by [12]. First, voluntary participation ensures that respondents are not coerced into participating in the study. Second, informed consent requires that participants fully know the study's purpose, potential benefits, risks, and funding sources before deciding whether to participate. Third, anonymity guarantees that the participants' identities remain unknown to external observers. Fourth, confidentiality ensures that while the researchers may know the participants' identities, all identifying information is removed from the final report. Fifth, potential physical, social, or psychological harm is minimized to the greatest extent possible. Lastly, results communication mandates that the researchers uphold integrity by avoiding plagiarism or research misconduct and accurately representing the study's findings.

RESULTS AND DISCUSSIONS

Profile of Respondents

Table 1 presented the frequency and relative frequency of the respondents based on sex. Out of 24 respondents, 10 (42%) were male, while 14 (58%) were female. These figures indicate that most of the respondents were female.

Table 1. Distribution of respondents

Variables	Frequency	Percentage
Sex		
Male	10	42%

Female	14	58%
Age		
12 years	4	17%
13 years	11	46%
14 years	5	21%
15 years	2	8%
16 years	1	4%
17 and above	1	4%

Furthermore, Table 1 illustrates respondents' frequency and relative frequency by age. Most of the respondents (46%) were 13 years old (n = 11), followed by 14-year-olds (21%, n = 5), 12-year-olds (17%, n = 4), and 15-year-olds (8%, n = 2). The least represented age groups were 16-year-olds and those aged 17 and above, comprising 4% (n = 1) of the total respondents. These results indicate that the dominant age group in the study was 13 years old.

Performance Before and After Implementing the Think-Pair-Share Strategy

Table 2 displayed students' pre-test and post-test results using the Think-Pair-Share strategy. The results indicate a significant improvement in students' performance after applying the strategy. The pre-test scores were generally lower, while post-test scores showed a marked increase, suggesting that the strategy effectively enhanced students' understanding and engagement in collaborative learning.

Table 2. Student Performance Before and After Using Think-Pair-Share Strategy

Variables	Pretest	Percentage	Post Test	Percentage
5	0	0%	15	63%
4	1	4%	4	17%
3	5	21%	3	13%
2	14	58%	2	8%
1	4	17%	0	0%

The mean post-test score (3.5) and standard deviation (0.2137) fall under the "Very Satisfactory" category, supporting the conclusion that Think-Pair-Share significantly enhanced students' academic performance in Mathematics.

Performance Before and After Implementing the Jigsaw Strategy

Table 3 swhoed students' pre-test and post-test scores using the Jigsaw strategy. Like the Think-Pair-Share results, the post-test scores reflect a considerable improvement in student performance. The mean posttest score (3.4) and standard deviation (0.1592) classify the performance as "Very Satisfactory." These results indicate that the Jigsaw strategy effectively fosters collaborative learning and engagement in Mathematics.

Table 3. Student Performance Before and After Using Jigsaw Strategy

Variables	Pretest	Percentage	Post Test	Percentage
5	0	0%	4	17%
4	4	17%	8	33%
3	8	33%	10	42%
2	5	21%	4	17%
1	7	29%	2	8%

Performance Before and After Implementing the Group Work Strategy

Table 4 illustrated students' pre-test and post-test performance using the Group Work strategy. The results indicate a significant improvement in academic performance following the implementation of the strategy.

Table 4. Student Performance Before and After Using Group Work Strategy

Variables	Pretest	Percentage	Post Test	Percentage
5	3	13%	6	25%
4	2	8%	10	42%
3	7	29%	11	46%
2	10	42%	3	13%
1	5	21%	0	0%

The mean post-test score (3.4) and standard deviation (0.1458) also classify the Group Work strategy as "Very Satisfactory." These results suggest that Group Work fosters a positive collaborative learning environment, enhancing student performance in Mathematics.

Relationship Between Collaborative Learning Strategies and Academic Performance

Table 5 presented the correlation between implementing collaborative learning strategies and students' academic performance. The Spearman correlation coefficients and p-values indicate a significant relationship between Think-Pair-Share, Jigsaw, and Group Work strategies and academic performance.

Table 5. Relationship Between Collaborative Learning Strategies and Academic Performance

Strategy	Spearman's r	p-value	Interpretation	Decision on H_o
Think-pair-share	0.090	0.429	Significant	Reject
Jigsaw	0.002	0.375	Significant	Reject
Group Works	0.001	0.225	Significant	Reject

The results suggest that all three collaborative learning strategies significantly positively affect students' academic performance.

CONCLUSION

The findings demonstrate that Think-Pair-Share, Jigsaw, and Group Work strategies significantly enhance student engagement and performance in Mathematics. The statistical analysis confirms a strong relationship between these collaborative learning strategies and academic achievement, highlighting the importance of active learning approaches in education. These results presumed that such strategies may be particularly beneficial for students of varying skill levels, though further research is needed to explore this aspect. Future studies could examine additional factors, such as teacher facilitation, classroom dynamics, and student motivation, to better understand the effectiveness of these methods across different grade levels and subject areas. Additionally, acknowledging potential study limitations could provide valuable insights for future investigations.

Ethical Considerations

Ethical approval was obtained for research involving human subjects and there is no conflict of interest in this study.

Data Availability

All data will be available upon publication.

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