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From Interaction to Effective Insights: Social Learning Strategies on Students' Engagement in Mathematics

Maricar D. Gines [1]
1 – Abra State Institute of Sciences and Technology

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Abstract

The aim of this study is to examine the engagement levels of Grade 7 students in Mathematics at Tamac Integrated School using three social learning strategies: collaborative learning, reciprocal teaching, and peer teaching. Objectives were to determine students' Mathematics performance before and after the strategies, assess their engagement across cognitive, behavioral, emotional, and social domains, and identify significant differences between pre-intervention and post-intervention results.

Data were collected using a survey checklist adapted from Dr. Victoria E. Tamban's engagement tool and a Mathematics performance test. Weighted mean and t-test were employed for analysis.

Findings revealed that students began with only a basic understanding of mathematical concepts, particularly struggling with computation and data management. Peer teaching increased social interaction but highlighted the need for more relaxed and supportive environments. Reciprocal teaching moderately improved behavioral and emotional engagement but was less effective in cognitive and social aspects. Collaborative learning yielded the strongest results, significantly enhancing both cognitive and behavioral engagement. Lastly, students actively participated, demonstrated better problem-solving skills, and showed reduced anxiety, though emotional and social engagement remained lower.

In terms of performance, all three strategies contributed to meaningful improvements. Peer teaching fostered confidence and motivation, reciprocal teaching supported comprehension, and collaborative learning promoted deeper understanding and participation. Post-test results showed significant gains, confirming the effectiveness of these methods in enhancing both engagement and achievement.

In conclusion, the study recommends that Mathematics instruction incorporate these social learning strategies, adjusted according to lesson content. A supplementary tool guide derived from this research can aid teachers in implementation and be refined for quarterly use in Grade 7 Mathematics. Future efforts should strengthen emotional and social aspects of engagement alongside cognitive and behavioral development.

Keywords: *Social learning strategies; Mathematics engagement; Peer teaching; Collaborative learning; Reciprocal teaching, Pre-intervention and Post-intervention results*

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I. INTRODUCTION

Mathematics is a fundamental subject that develops problem-solving, critical thinking, and analytical skills, serving as a foundation for fields like science, technology, engineering, and economics. Active classroom engagement is essential for students to understand and apply concepts effectively. Participation, questioning, and collaboration deepen understanding, build confidence, and foster curiosity and perseverance. However, the teacher-researcher observed that most students in mathematics class show low participation and engagement.

Social interaction is essential for effective collaboration, as the quality of student discussions—explaining ideas, arguing, and building on peers' thoughts—promotes deeper understanding and cognitive restructuring (Barron, 2019). Collaborative learning has been linked to higher academic achievement, critical thinking, peer support, persistence in university, and positive attitudes toward instructors (Loes et al., 2018; Trolian, 2020).

Social learning strategies include Reciprocal Teaching, which engages students in predicting, clarifying, questioning, and summarizing content to enhance comprehension across subjects (Juraschka, 2021), and Peer Teaching, where learners teach each other under teacher supervision, boosting motivation and social standing (Atieh, 2018; Wentzel, 2019). Collaborative Learning, where students work in small, diverse groups with defined roles, has been shown to improve engagement, retention, mastery, and interpersonal skills (Slavin, 2022; Spence, 2020; Dillenbourg, 2019).

These strategies align with the UN Sustainable Development Goals, particularly Goal 4, promoting inclusive, equitable, and high-quality education. Mathematics, as a foundational subject, benefits greatly from such approaches, as traditional textbook-focused teaching may fail to engage students. Understanding social, cognitive, behavioral, and emotional engagement in mathematics is crucial, prompting this study to explore social learning strategies that enhance student engagement.

1. This study aimed to examine the engagement of Grade 7 students in mathematics at Tamac Integrated School through the use of social learning strategies. It focused on determining students' mathematics performance before and after applying collaborative learning, reciprocal teaching, and peer teaching. The study also assessed the students' cognitive, behavioral, emotional, and social engagement following these strategies. Additionally, it investigated whether there were significant differences in engagement among the three strategies and whether the integration of social learning strategies led to measurable improvements in students' mathematics performance.

II. MATERIALS and METHODS

Research Design

The study used a quantitative research design, converting data into numerical form for statistical analysis and conclusions. Employing a descriptive-experimental approach, it measured the effectiveness of collaborative learning, reciprocal teaching, and peer teaching on Grade 7 students' engagement in mathematics. Pre- and post-evaluations were conducted to assess changes in engagement. This combined method allowed the researcher to both describe existing

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levels of engagement and academic performance and systematically examine the impact of the social learning strategies (Creswell, 2014; Leedy & Ormrod, 2019).

Participants

The chosen respondents were the (26) twenty-six Grade 7 students of the said school who are currently enrolled for the School Year 2024-2025.

Instruments

The researcher used a survey checklist to measure students' engagement in mathematics, based on Victoria E. Tamban, Ed.D. (2021). Engagement was assessed across four categories: cognitive, behavioral, emotional, and social, each with ten statements. For the pre-test and post-test, questions were adopted from the Grade 7 Mathematics Matatag Curriculum book.

Procedure

The researcher obtained approval from the School Head of Tamac Integrated School to conduct the study. The three strategies—collaborative learning, reciprocal teaching, and peer teaching—were applied throughout the quarter. Pre- and post-evaluations were conducted, and student responses were analyzed using weighted means, t-tests, and ANOVA. The results informed the development of a best-practices guide for these strategies, and the final paper was submitted for ethics review.

Data Analysis

Weighted means were applied to determine students' pre- and post-evaluation results in engagement and mathematics performance. To assess significant differences before and after implementing collaborative learning, reciprocal teaching, and peer teaching, t-tests and ANOVA were conducted using a one-group pretest-posttest design.

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III. RESULT and DISCUSSION

Table 1. The Level of Mathematics Performance of Grade 7 Students before using the Social Learning Strategies

Topics	Mean (x)	Descriptive Rating (DR)
Data Collection and Sampling Techniques	70	Did Not Meet Expectations
Frequency Distribution Table	70	Did Not Meet Expectations
Data Presentation	69	Did Not Meet Expectations
Understanding Integers	74	Did Not Meet Expectations
Adding and Subtracting Integers	71	Did Not Meet Expectations
Total	71	Did Not Meet Expectations

Assessment showed that students' overall performance in mathematics was low, with a total mean score of 71, rated as "Did Not Meet Expectations." Topic scores were similarly low: Topic 1 ("Data Collection and Sampling Techniques") scored 70, Topic 2 ("Frequency Distribution Table") 70, Topic 3 ("Data Presentation") 69, Topic 4 ("Understanding Integers") 74, and Topic 5 ("Adding and Subtracting Integers") 71, all falling below expectations. These results indicate that while students have basic mathematical knowledge, they struggle particularly with computation and data management skills.

These findings align with previous studies highlighting Filipino students' challenges with higher-order thinking and application of mathematical concepts. Magayon & Tabuzo (2024) noted difficulties in solving contextual problems and applying concepts in real-world scenarios, while Tan (2019) linked low numeracy skills to both cognitive and motivational factors. Similarly, Obut et al. (2024) and Gomez & Velez (2023) reported struggles in handling complex problems, interpreting data, and applying theoretical knowledge, emphasizing gaps between foundational understanding and practical application.

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Table 2.1.1.Level of Engagement of Grade 7 Students in Mathematics class after the Application of the Peer-to Peer Strategies as to cognitive engagement.

Cognitive	Mean (X)	Descriptive Rating (DR)
1.I answer math problems easily because I understand our math lessons.	3.35	Engage
2. I try to develop my own strategy when I solve math problems.	3.00	Engage
3. When I study math, I ask myself questions to make sure I understand it correctly	3.00	Engage
4. I try to connect math to real life situations.	3.23	Engage
5. I set a goal for myself when I study math.	4.00	Highly Engage
6. When I can't solve a math problem, I try to change my strategy.	3.50	Highly Engage
7. I follow my best guess when I do not know the answer in math problems.	3.00	Engage
8. I am aware of my strengths and weaknesses in math.	2.49	Not Engage
9. I pay attention to my math teacher every time, in our class.	3.00	Engage
10. I try to recall the steps in solving math problems.	3.00	Engage
Submean	**3.15**	**Engage**

Table 2.1 shows that the peer-to-peer strategy improved Grade 7 students' engagement in mathematics. Cognitive engagement had a sub-mean of 3.20, rated as "Engaged," with the highest score for "I set a goal for myself when I study math" (4.0, Highly Engaged) and the lowest for "I am aware of my strengths and weaknesses in math" (2.49, Not Engaged). This suggests that peer-to-peer learning positively impacts cognitive engagement but students may still need more relaxed social opportunities to build confidence. Fletcher et al. (2023) note that cognitive engagement develops through guided practice, feedback, and strategic thinking, while Ryan & Deci (2020) emphasize that autonomy, competence, and relatedness enhance intrinsic motivation. Environments that allow choice, meaningful collaboration, and self-expression foster sustained engagement, better academic outcomes, and improved emotional well-being.

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Table 2.1.2. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Peer-to-Peer Strategies as to Behavioral engagement

Behavioral	Mean (X)	Descriptive Rating (DR)
1. I listen intently to my teacher in my math class.	3.55	Highly Engage
2. I actively participate in solving math problems during class.	3.00	Engage
3. I avoid distractions especially during my math class.	2.96	Engage
4. I work hard to solve math problems in my math class.	3.77	Highly Engage
5. I spend more time on my math problems at home to improve my understanding.	3.19	Engage
6. I do not stop working, when I see difficult math problems.	2.92	Engage
7. I do not skip difficult math questions.	3.04	Engage
8. I continue solving math problems until I get the correct answer.	2.96	Engage
9. I attend math classes regularly without skipping.	4.00	Highly Engage
10. I ask my friends or teachers for help when I can't solve math problems.	3.70	Highly Engage
Submean	**3.30**	**Engage**

In terms of behavioral engagement, Grade 7 students showed moderate participation in math activities, with a sub-mean of 3.30, rated as "Engaged." The highest score (4.0) was for attending classes regularly, while the lowest (2.92) was for persisting on difficult problems. This suggests that peer-to-peer learning improved student behavior. Supporting this, Pi et al. (2023) found that students paired with familiar peers showed higher motivation and self-monitoring, and Idowu (2022) reported that peer-to-peer strategies enhance both academic performance and social behaviors compared to conventional methods.

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Table 2.2.3. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Reciprocal Teaching Strategies as to emotional engagement.

Emotional	Mean (X)	Descriptive Rating (DR)
1. I am interested in learning new things in math.	3.00	Engage
2. I enjoy attending math classes and participating in activities.	2.00	Not Engage
3. I enjoy learning about numbers.	3.00	Engage
4. I feel anxious when I make mistake in math.	3.00	Engage
5. I am not bored when I study in math.	2.00	Not Engage
6. I am excited about solving difficult math problems.	3.00	Engage
7. I would rather study other subjects than math.	2.00	Not Engage
8. I feel a sense of satisfaction when I overcome challenges in math.	2.54	Engage
9. I am confident when I study math.	2.00	Not Engage
10. I am not stressed when doing my assignments in math.	3.00	Engage
Submean	2.55	Engage

The table shows that students' emotional engagement was rated "Engaged," though only narrowly, with a sub-mean of 2.55. They enjoyed learning numbers and solving problems (mean = 3), but showed low interest in attending classes and avoiding boredom (mean = 2). This indicates moderate emotional engagement, with a need for strategies to boost enthusiasm. Martinez & Gomez (2024) stress the importance of meaningful, relevant tasks, while Ranta et al. (2024) and Zitzmann et al. (2024) highlight that instructional context and positive emotions strongly influence enjoyment and deeper involvement in math.

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Table 2.2.4. Level of Engagement of Grade 7 Students in Mathematics class after Application of the Reciprocal Teaching Strategies as to social engagement.

Social	Mean (X)	Descriptive Rating (DR)
1. I feel comfortable working with my classmates in my math class.	2.50	Engage
2. I actively participate in group discussion in my math class.	2.23	Not Engage
3. I listen carefully to my teacher's explanation in math class.	2.69	Engage
4. I offer help to my classmates who are struggling in math.	2.62	Engage
5. I feel comfortable asking math questions in my group discussions.	2.50	Engage
6. I feel happy working with my classmates in my math class.	2.70	Engage
7. I try to understand other people's ideas in my math class.	2.58	Engage
8. I care about other people ideas in my math class.	2.54	Engage
9. I share ideas when working with others in my math class.	2.19	Not Engage
10. I try to work with others who can help me in math problems.	2.38	Not Engage
Submean	2.49	Engage

The table indicates that students' social engagement was rated "Not Engaged," with a sub-mean of 2.49. While they showed some comfort working with classmates and listening to the teacher (mean = 2.70), they scored low in group discussions and idea sharing (means = 2.23 and 2.19). This suggests limited peer interaction. Mafarja et al. (2023) and Ruangprasertkun & Chinwonno (2023) highlight that reciprocal teaching fosters communication, metacognition, and cooperative learning by guiding students through predicting, questioning, clarifying, and summarizing—skills that can enhance social engagement in class.

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Table 2.2.5. Summary Table on the Level of Engagement of Grade 7 Students of Tamac Integrated School in Mathematics class after the Application of Reciprocal Teaching Strategy.

Indicators of Engagement	Mean (X)	Descriptive Rating (DR)
Cognitive	3.06	Engage
Behavioral	2.55	Engage
Emotional	2.49	Not Engage
Social	2.49	Not Engage
Overall	2.64	Engage

Table 2.2.5 shows that after applying the Reciprocal Teaching Strategy, Grade 7 students had an overall weighted mean of 2.67 ("Engaged"). Cognitive engagement scored highest at 3.06, followed by behavioral (2.55), while emotional and social engagement both scored 2.49 ("Not Engaged"). This suggests that Reciprocal Teaching moderately boosts cognitive and behavioral engagement but has limited impact on emotional and social aspects. Supporting studies by Mehmood & Alvi (2023) and Mafarja et al. (2024) confirm that while RT enhances comprehension, metacognition, and participation, its effect on emotional and social engagement requires intentional design.

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Table 2.3.1. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Collaborative Teaching Strategies as to cognitive engagement.

Cognitive	Mean (X)	Descriptive Rating (DR)
1.I answer math problems easily because I understand our math lessons.	3.35	Engage
2. I try to develop my own strategy when I solve math problems.	3.00	Engage
3. When I study math, I ask myself questions to make sure I understand it correctly	3.00	Engage
4. I try to connect math to real life situations.	2.73	Engage
5. I set a goal for myself when I study math.	3.77	Highly Engage
6. When I can't solve a math problem, I try to change my strategy.	3.46	Highly Engage
7. I follow my best guess when I do not know the answer in math problems.	3.00	Engage
8. I am aware of my strengths and weaknesses in math.	3.00	Engage
9. I pay attention to my math teacher every time, in our class.	3.35	Engage
10. I try to recall the steps in solving math problems.	3.00	Engage
Submean	3.16	Engage

The study found that Grade 7 students achieved a sub-mean of 3.16 in cognitive engagement after applying the Collaborative Learning Strategy, rated as “Engaged.” The highest score was for setting study goals (3.77, Highly Engaged), while the lowest was for connecting math to real-life situations (2.73). This suggests that while students are motivated in problem-solving, they need support in applying concepts to real contexts. Palisbo et al. (2025) confirm that collaborative rotation strategies, which foster dialogue, problem-solving, and peer feedback, significantly improve engagement, confidence, and understanding in mathematics.

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Table 2.3.2. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Collaborative Teaching Strategies as to behavioral engagement

Behavioral	Mean (X)	Descriptive Rating (DR)
1. I listen intently to my teacher in my math class.	3.65	Highly Engage
2. I actively participate in solving math problems during class.	3.00	Engage
3. I avoid distractions especially during my math class.	2.96	Engage
4. I work hard to solve math problems in my math class.	3.77	Highly Engage
5. I spend more time on my math problems at home to improve my understanding.	3.35	Engage
6. I do not stop working, when I see difficult math problems.	3.08	Engage
7. I do not skip difficult math questions.	3.08	Engage
8. I continue solving math problems until I get the correct answer.	3.14	Engage
9. I attend math classes regularly without skipping.	4.00	Highly Engage
10. I ask my friends or teachers for help when I can't solve math problems.	3.69	Highly Engage
Submean	3.37	Engage

After exposure to collaborative learning, Grade 7 students recorded their highest engagement in the behavioral domain, with a sub-mean of 3.37 ("Engaged"). Attendance was rated highest (4.0, Highly Engaged), while persistence with difficult problems scored lower (3.08). This indicates strong compliance but weaker perseverance. Rashid & Khan (2023) support this by showing that collaborative methods enhance problem-solving persistence, while Middleton et al. (2022) highlight that scaffolding tasks can strengthen perseverance and strategy use when students encounter challenges.

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Table 2.3.3. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Collaborative Teaching Strategies as to emotional engagement.

Emotional	Mean (X)	Descriptive Rating (DR)
1. I am interested in learning new things in math.	3.38	Engage
2. I enjoy attending math classes and participating in activities.	3.00	Engage
3. I enjoy learning about numbers.	3.00	Engage
4. I feel anxious when I make mistake in math.	3.00	Engage
5. I am not bored when I study in math.	3.00	Engage
6. I am excited about solving difficult math problems.	3.00	Engage
7. I would rather study other subjects than math.	2.50	Engage
8. I feel a sense of satisfaction when I overcome challenges in math.	2.81	Engage
9. I am confident when I study math.	2.35	Not Engage
10. I am not stressed when doing my assignments in math.	3.00	Engage
Submean	2.90	Engage

The table shows that emotional engagement had the highest sub-mean at 2.90 (“Engaged”). Interest in learning new things in math scored highest (3.38), while confidence in studying math was lowest (2.35). This suggests that although students are interested, they lack persistence and confidence with difficult problems. Middleton et al. (2022) support this, noting that perseverance can be developed through scaffolding strategies such as guided prompts and step-by-step questioning, which also help regulate frustration and sustain effort in problem-solving.

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Table 2.3.4. Level of Engagement of Grade 7 Students in Mathematics class after the Application of Collaborative Teaching Strategies as to social engagement.

Social	Mean (X)	Descriptive Rating (DR)
1. I feel comfortable working with my classmates in my math class.	3.00	Engage
2. I actively participate in group discussion in my math class.	2.90	Engage
3. I listen carefully to my teacher's explanation in math class.	3.00	Engage
4. I offer help to my classmates who are struggling in math.	3.00	Engage
5. I feel comfortable asking math questions in my group discussions.	2.50	Engage
6. I feel happy working with my classmates in my math class.	3.30	Engage
7. I try to understand other people's ideas in my math class.	3.30	Engage
8. I care about other people ideas in my math class.	3.00	Engage
9. I share ideas when working with others in my math class.	3.00	Engage
10. I try to work with others who can help me in math problems.	3.00	Engage
Submean	3.00	Engage

The table shows that students' social engagement had a sub-mean of 3.00 ("Engaged"). They expressed the most comfort in working with classmates and understanding others' ideas (mean = 3.30), but felt less comfortable asking questions in group discussions (mean = 2.50), suggesting some lingering social discomfort. Catubig (2023) supports this, noting that student-centered approaches—such as giving autonomy, connecting lessons to real-life, and encouraging reflection—help nurture intrinsic motivation. These practices strengthen both cognitive and emotional engagement, which are key to sustaining students' effort and resilience in mathematics.

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Table 2.4.5. Summary Table on the Level of Engagement of Grade 7 Students of Tamac Integrated School in Mathematics class after the Application of Collaborative Teaching Strategy.

Indicators of Engagement	Mean (X)	Descriptive Rating (DR)
Cognitive	3.12	Engage
Behavioral	3.37	Engage
Emotional	3.05	Engage
Social	3.10	Engage
Overall	**3.16**	Engage

The table shows that after applying the Collaborative Teaching Strategy, Grade 7 students at Tamac Integrated School demonstrated consistent engagement across all domains—cognitive (3.13), behavioral (3.37), emotional (3.06), and social (3.11)—with an overall mean of 3.17, rated as "Engaged." Behavioral engagement scored the highest, indicating active participation and adherence to classroom norms, while the slightly lower scores in cognitive, emotional, and social areas suggest room for strengthening deeper understanding, emotional connection, and peer collaboration.

These results align with Taban-Od & Dorinio (2024), who found that collaborative learning strategies enhance multiple domains of engagement through peer discussions, group problem-solving, and cooperative tasks. Similarly, Palisbo et al. (2025) emphasized the role of collaborative rotations in boosting engagement and performance, while Catubig (2023) highlighted the importance of student-centered approaches in fostering intrinsic motivation and emotional connections to mathematics. Together, these studies affirm that collaborative strategies effectively build behavioral and cognitive engagement, though teachers must also design lessons that enhance social support and emotional involvement.

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Table 3.1 Level of Mathematics Performance of Grade 7 Students after using the Peer-to-Peer Learning Strategy

Topics	No. Of Items	Mean (x)	Descriptive Rating (DR)
Data Collection and Sampling Techniques	10	87.6	Very Satisfactory
Frequency Distribution Table	10	87.6	Very Satisfactory
Data Presentation	10	86.9	Very Satisfactory
Understanding Integers	6	83.8	Satisfactory
Adding and Subtracting Integers	4	99.0	Outstanding
Total	40	88.75	Very Satisfactory

The table indicates that the post-test mean scores across all topics were high, with an overall mean of 88.75 ("Very Satisfactory") after the implementation of the peer-to-peer learning strategy. This shows a substantial improvement in mathematics performance, suggesting that collaboration enables students to participate actively, clarify misunderstandings, and reinforce learning through teaching and discussion.

These results are supported by Flores & Dizon (2024), who found that peer tutoring programs produced 41% higher gains in math achievement compared to lecture-based methods, enhancing problem-solving, accuracy, and attitudes toward mathematics. Similarly, Zhou & Ling (2023) reported that peer-to-peer activities fostered higher-order thinking and deeper conceptual understanding. In line with this, a 2024 DepEd research brief on Peer-Assisted Learning Strategies (PALS) revealed that students in pilot schools improved by at least one descriptive level in math competency, with additional benefits such as stronger motivation, reduced anxiety, and better classroom dynamics.

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Table 3.2. Level of Mathematics Performance of Grade 7 Students after using the Reciprocal Learning Strategy

Topics	Mean (x)	Descriptive Rating (DR)
Data Collection and Sampling Techniques	79.0	Fairly Satisfactory
Frequency Distribution Table	78.0	Fairly Satisfactory
Data Presentation	82.6	Satisfactory
Understanding Integers	90	Outstanding
Adding and Subtracting Integers	91.25	Outstanding
Total	84.17	Satisfactory

As shown in the table, post-test mean scores ranged from 78.0 to 140.0, with most topics rated "Very Satisfactory" or "Excellent." The overall mean rose to 79.6 ("Very Satisfactory"), indicating that the Reciprocal Learning Strategy effectively improved Grade 7 students' mathematics performance.

This finding aligns with Hernandez & Gutierrez (2024), who reported that reciprocal teaching enhanced understanding of complex topics, particularly in mathematics, with students taking on the "teacher" role showing stronger retention and conceptual mastery. Similarly, Smith & Richards (2023) found that reciprocal learning significantly improved mathematical problem-solving skills. Martinez et al. (2025) further highlighted that reciprocal learning not only raised academic performance but also strengthened peer relationships and reduced math anxiety, as students felt more confident discussing and solving problems with peer support.

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Table 3.3. Level of Mathematics Performance of Grade 7 Students after using the Collaborative Learning Strategy

Topics	No. Of Items	Mean (x)	Descriptive Rating (DR)
Data Collection and Sampling Techniques	10	65.0	Very Satisfactory
Frequency Distribution Table	10	68.4	Very Satisfactory
Data Presentation	10	69.2	Very Satisfactory
Understanding Integers	6	80.0	Excellent
Adding and Subtracting Integers	4	70.0	Very Satisfactory
Total	40	69.7	Very Satisfactory

Table 3.3 presents the mathematics performance of Grade 7 students after applying the Collaborative Learning Strategy. Post-test scores ranged from 65.0 to 80.0, with most topics rated "Very Satisfactory" and one rated "Excellent." The overall mean rose to 69.7 ("Very Satisfactory"), showing that collaborative learning improved performance, boosted motivation, and reduced math anxiety as students supported one another.

Bowers & Lee (2023) similarly found that collaborative learning enhanced mathematics achievement, problem-solving skills, and attitudes toward learning. Nguyen & Park (2024) also reported that group work increased student confidence and persistence in solving challenging tasks, leading to better assessment results. Likewise, Thompson et al. (2025) emphasized that collaborative learning not only raised academic performance but also strengthened social interactions and fostered a greater sense of community, contributing to higher achievement in mathematics.

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Table 4. Significant Difference Between The Level Of Engagement Of Grade 7 Students In Mathematics Class As To Cognitive, Behavioral, Emotional, And Social Among The Three Social Learning Strategies

Engagement Variables	F-computed	f-critical	F-probablity value	Interpretation
Cognitive	23.251**	3.119	1.39E-08 p<0.01	Highly Significant
Behavioral	101.317**	3.119	4.84E-22 p<0.01	Highly Significant
Emotional	44.88**	3.119	1.52E-13 p<0.01	Highly Significant
Social	56.45**	3.119	1.1E-15 p<0.01	Highly Significant
Total	8.811**	3.119	1.41E-19 p<0.01	Highly Significant

Table 4 shows a significant difference in student engagement across cognitive, behavioral, emotional, and social domains when the three social learning strategies were applied, with an overall F-value of 8.811 higher than the f-critical of 3.119. This indicates that choosing the right strategy leads students to think more deeply, act more responsibly, feel more positive, and connect better with peers. Specifically, cognitive engagement ($F=23.25$, $p<0.01$) improved when tasks involved collaboration, reasoning, and questioning, supporting Hadwin et al. (2020) and Lopez & Gonzalez (2021) who found that socially shared regulation and peer discussions foster deeper thinking. Behavioral engagement ($F=101.31$, $p<0.01$) also showed a highly significant difference, with students more attentive and participative in structured group activities—echoing Fredricks et al. (2023) and the NRC (2021) who emphasized peer teaching and cooperative problem-solving as effective in reducing off-task behaviors.

Emotional engagement ($F=44.88$, $p<0.01$) varied significantly, with students more relaxed and connected in supportive, peer-driven settings. This aligns with Pekrun et al.'s (2020) Control-Value Theory and CASEL's (2022) emphasis on SEL practices that reduce anxiety and foster positive emotions. Lastly, social engagement ($F=56.45$, $p<0.01$) revealed that peer interaction and collaboration were crucial, as students enjoyed learning more when sharing ideas and supporting each other. These findings confirm Ryan & Deci's (2023) Self-Determination Theory, which highlights relatedness as key to motivation, and are further supported by Lee & Reeve (2021) and Gurung et al. (2022), who demonstrated that fostering collaboration and peer relationships enhances both performance and enthusiasm in learning.

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Table 5.1. Significant Difference Between The Level Of Mathematics Performance Of Respondents Before And After Integrating The Social Learning Strategies In Teaching-Learning Process (Collaborative)

Topic	t-computed	t-critical	t-probability value	Interpretation
Data Collection and Sampling Techniques	16.006**	1.708	6E-15 p<0.01	Highly Significant
Frequency Distribution Table	22.271**	1.708	2.64E p<0.01	Highly Significant
Data Presentation	21.180**	1.708	8.71E-18 p<0.01	Highly Significant
Understanding Integers	18.621**	1.708	1.81E-16 p<0.01	Highly Significant
Adding and Subtracting Integers	11.508**	1.708	8.76E-12 p<0.01	Highly Significant
Total	41.699**	1.708	6.22E-25 p<0.01	Highly Significant

Table 5.1 reveals a very highly significant difference in mathematics performance of Grade 7 students before and after the use of collaborative teaching, with an overall t-computed value of 41.699 and p-value of 6.22E-25 ($p < 0.01$). Across all topics—Data Collection and Sampling Techniques, Frequency Distribution Table, Data Presentation, Understanding Integers, and Adding/Subtracting Integers—the computed t-values far exceeded the critical value of 1.708, all with p-values less than 0.01, confirming highly significant improvements. These results indicate that collaborative learning strategies had a strong positive impact on students' achievement in mathematics.

These findings align with Alzahrani (2020), who emphasized Vygotsky's Social Development Theory where peer interaction fosters deeper understanding, and Siller & Ahmad (2024), who reported significant gains in mathematics achievement and attitudes through collaborative learning. Locally, Palisbo et al. (2025) showed that Collaborative Rotation Strategy improved problem-solving and communication among Grade 8 students, while Abd Algani (2021) found that collaborative settings increased confidence and academic performance. Together, these studies affirm that collaborative learning not only boosts mathematical comprehension but also enhances engagement, peer support, and self-efficacy.

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Table 5.2. Significant Difference Between The Level Of Mathematics Performance Of Respondents Before And After Integrating Social Learning Strategies In The Teaching-Learning Process (Reciprocal Teaching)

Topic	t-computed	t-critical	t-probablity value	Interpretation
Data Collection and Sampling Techniques	12.199**	1.708	2.52E-12 p<0.01	Highly Significant
Frequency Distribution Table	1.433	1.708	0.08 p<0.01	Not Significant
Data Presentation	17.609**	1.708	6.65E-16 p<0.01	Highly Significant
Understanding Integers	9.383**	1.708	5.70E-10 p<0.01	Highly Significant
Adding and Subtracting Integers	17.339**	1.708	9.51E-16 p<0.01	Highly Significant
Total	28.529**	1.708	6.78E-21 p<0.01	Highly Significant

Table 5.2 shows a significant improvement in students' mathematics performance after applying reciprocal teaching, with an overall t-computed value of 28.529 far exceeding the critical value ($p < 0.01$). Most topics—Data Collection and Sampling Techniques, Data Presentation, Understanding Integers, and Adding/Subtracting Integers—recorded highly significant gains, while Frequency Distribution Table showed no significant change ($t = 1.433$, $p = 0.08$). These findings confirm that reciprocal teaching was effective in enhancing conceptual and procedural learning in mathematics.

Supporting studies highlight similar outcomes. Alfaro (2020) noted that reciprocal teaching improved students' reasoning in data handling and number operations, while Duran (2020) found that it boosted confidence and comprehension of word problems. Obioma & Ugwuegbulam (2023) reported long-term gains in mathematical reasoning, and Mulyon et al. (2025) affirmed strong positive effects through meta-analysis. Further evidence from Taokaew et al. (2022) showed enhanced problem-solving via structured reciprocal teaching, and Mafarja et al. (2022) linked the approach to improved academic self-concept and sustained motivation. Together, these findings underscore reciprocal teaching's effectiveness in promoting higher achievement, problem-solving ability, and learner confidence.

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Table 5.3. Significant Difference Between the Level Of Mathematics Performance Of Respondents Before And After Integrating Social Learning Strategies In The Teaching-Learning Process (Peer-to-Peer Teaching)

Topic	t-computed	t-critical	t-probablity value	Interpretation
Data Collection and Sampling Techniques	19.284**	1.708	7.97E-17 p<0.01	Highly Significant
Frequency Distribution Table	25.00**	1.708	1.65E-19 p<0.01	Highly Significant
Data Presentation	22.054**	1.708	3.33E-18 p<0.01	Highly Significant
Understanding Integers	14.422**	1.708	6.34E-14 p<0.01	Highly Significant
Adding and Subtracting Integers	15.161**	1.708	2.06E-14 p<0.01	Highly Significant
Total	42.046**	1.708	5.07E-25 p<0.01	Highly Significant

Table 5.3 shows that peer-to-peer teaching had a strong positive impact on students' mathematics performance, with an overall t-computed value of 42.046 ($p < 0.01$). All five topics—Data Collection and Sampling Techniques ($t = 19.284$), Frequency Distribution Table ($t = 25.00$), Data Presentation ($t = 22.054$), Understanding Integers ($t = 14.422$), and Adding and Subtracting Integers ($t = 15.161$)—recorded highly significant improvements compared to pre-test scores. These results confirm that peer-assisted learning strategies effectively enhance both conceptual understanding and procedural fluency in mathematics.

Supporting literature further reinforces these findings. Leung et al. (2020) observed that peer-assisted learning improves test performance, reasoning, and communication skills through the use of relatable, student-friendly explanations. Similarly, Wang & Wang (2019) and Molner & Alegre (2020) reported that peer tutoring fosters deeper understanding, greater participation, and reduced math anxiety. More recent studies add to this evidence: Aygun (2024) found that peer-assisted strategies improved problem-solving and self-awareness in flipped classrooms, while Duran et al. (2020) showed significant gains in mathematics self-concept, with an average increase of 13.4% in experimental groups. Together, these studies highlight that peer-to-peer teaching not only strengthens mathematics achievement but also promotes confidence, motivation, and positive attitudes toward learning.

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Table 6.1. Significant difference between and among level of performance when grouped according to strategy.

TOPIC	F-computed	F-critical	F-Probability	Interpretation
Data Collection and Sampling Techniques	74.445**	3.119	1.54E.18 p<0.01	Highly Significant
Frequency Distribution Table	45.029	3.119	1.42E-B p<0.01	Highly Significant
Data Presentation	51.213	3.119	9.48E-15 p<0.01	Highly Significant
Understanding Integers	2.302	3.119	0.107 p<0.05	Not Significant
Adding and Subtracting Integers	63.957	3.119	6.17E.17 p<0.01	Highly Significant
Total	290.053	3.119	5.05E-36 p<0.01	Highly Significant

Table 6.1 reveals that the teaching strategies significantly affected students' performance in most topics, particularly *Data Collection and Sampling Techniques, Frequency Distribution Table, Data Presentation,* and *Adding and Subtracting Integers,* all of which showed very high F-values and p-values below 0.01. However, *Understanding Integers* did not show a significant difference ($F = 2.302$, $p > 0.05$), suggesting that the strategies had little influence on this conceptual area. Overall, the total F-value of 290.053 ($p < 0.01$) confirms that strategy choice made a highly significant difference in mathematics achievement across topics. This implies that while instructional strategies strongly impact performance in complex or procedural areas, their effect may be limited in more conceptual lessons.

These findings align with prior research. Cagasan et al. (2021) and Reham et al. (2024) both highlighted that the effectiveness of a teaching strategy depends on the topic's nature and learners' cognitive styles, with active and problem-based methods proving most useful in analytical or skill-based areas. Similarly, Oribhabor (2020) found that activity-based teaching significantly improved Nigerian students' performance, motivation, and retention in mathematics compared to traditional instruction. Together, these studies affirm that no single approach is universally effective; strategies must fit both the subject content and learners' needs to maximize comprehension and engagement.

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Table 6.2. Summary of ANOVA showing the difference between and among level of performance when grouped according to strategy.

	Topic 1	2	3	4	5	Overall
Peer-To-Peer Teaching	87.60	87.60	86.90	83.83	99.00	88.98
Reciprocal Teaching	79.00	78.00	82.60	80.00	91.25	82.00
Collaborative Learning	65.00	68.40	69.20	80.00	70.00	70.52
F-Value	74.445**	45.029	51.213	2.302	63.957	290.053
F-Prob	1.54E.18	1.42E-B	9.48E-15	0.107	6.17E.17	5.05E

Table 6.2 summarizes the results of the ANOVA test assessing the difference between and among level of performance of the students when grouped according to three teaching strategies: Peer-to-Peer Teaching, Reciprocal Teaching, and Collaborative Learning. It can be seen that the mean performance scores for each strategy reveal that students who experienced Peer-to-Peer Teaching consistently outperformed their peers in most topics, with an overall average score of 88.98. Reciprocal Teaching followed with an average of 82.00, while Collaborative Learning trailed behind at 70.52. The F-values and their corresponding probability levels indicate that these differences are statistically significant for four out of the five topics (Topics 1, 2, 3, and 5), all showing p-values below 0.01. However, Topic 4 yielded an F-value of 2.302 with a p-value above 0.05, indicating no significant difference among strategies for that specific topic. The overall F-value of 290.053 with a p-value approaching zero confirms that, on the whole, teaching strategy has a highly significant effect on academic performance.

The results of the analysis imply that Peer-to-Peer Teaching is the most effective instructional strategy among those compared. Its consistent association with higher student performance across a range of topics implies that this strategy offers substantial advantages in promoting comprehension and academic success.The lack of significance in Topic 4 also highlights that for some content areas, the impact of instructional strategy may be minimal, suggesting a need for a more nuanced, topic-specific approach in curriculum delivery.

The implication is supported by the research study of Seller & Ahmad (2024) which indicated that students in the collaborative learning group showed significant improvements in mathematics achievement compared to those in the control group. Additionally, these students developed more positive attitudes toward mathematics, suggesting that collaborative learning not only enhances academic performance but also fosters a more favorable perception of the subject. The study underscores the importance of interactive and student-centered teaching strategies in promoting both cognitive and affective outcomes in mathematics education.

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Similarly, Pitafi et al. (2022) study revealed that students' perceptions of the benefits of Social Media-Based Collaborative Learning (SMBCL), their engagement in active learning, and their interactions with peers were significantly associated with enhanced collaborative learning experiences. Notably, students' academic self-efficacy was found to significantly moderate the relationship between SMBCL and learning performance, indicating that students with higher confidence levels derived greater benefits from collaborative learning facilitated through social media platforms.These results underscore the potential of social media platforms as effective tools for fostering collaborative learning environments that enhance student engagement, confidence, and academic achievement.

Furthermore, Wairimu et al (2023) findings revealed that students exposed to cooperative learning exhibited significantly higher achievement levels in chemistry compared to their counterparts in the traditional teaching group. This suggests that cooperative learning, which emphasizes student collaboration and active participation, can effectively enhance understanding and retention of complex scientific concepts. Similarly, Yaqoob & Rashid (2023) study indicated that both experimental groups outperformed the control group, demonstrating significant improvements in multiple-choice questions, reading comprehension, and writing abilities. These outcomes highlight the efficacy of interactive teaching strategies in enhancing language skills and overall academic performance.

Table 7.1 Level of Performance using Peer-to-Peer Teaching Learning Strategy.

Level of Engagement	Data collection and sampling	Frequency Distribution Table	Data Presentation	Understanding Integers	Adding and Subtracting Integers	Overall total
Cognitive	0.196	0.245	0.436*	0.277*	0.241	0.142
Behavioral	0.201	0.260	0.213	0.185	0.009	0.064
Emotional	0.049	0.184	0.531**	0.411*	0.183	0.311
Social	0.036	0.240	0.399*	0.317**	0.114	0.342
Overall total	0.105	0.295	0.525**	0.401*	0.172	0.307

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Table 7.1 shows that cognitive, emotional, and social engagement significantly correlate with better performance in *Data Presentation* and *Understanding Integers* when using peer-to-peer teaching. Students who were mentally invested, emotionally connected, and socially interactive achieved higher results, while behavioral engagement (attendance and participation) showed only weak correlations. This suggests that simply being present is not enough—deep thinking, emotional involvement, and peer collaboration are the real drivers of improved performance.

These findings echo prior studies. Li & Lalani (2022) noted that emotional engagement sustains persistence in challenging math tasks, while Kassim et al. (2023) found that structured peer interaction enhances problem-solving and conceptual understanding. Similarly, Tran et al. (2021) emphasized that cognitive engagement is the key success factor in peer-led learning, as students who engaged critically within groups performed better and retained deeper understanding. Overall, peer-to-peer teaching is most effective when it stimulates higher-order thinking, emotional investment, and meaningful peer collaboration rather than mere participation.

Table 7.2 Level of Performance using Reciprocal Teaching Learning Strategy.

Level of Engagement	Data collectic and samplin	Frequency Distribution Table	Data Presentation	Understanding Integers	Adding and Subtracting Integers	Overall total
Cognitive	0.203	0.468*	0.343	0.496**	0.345	0.179
Behavioral	0.218	0.139	0.097	0.059	0.288	0.053
Emotional	0.200	0.295	0.092	0.521**	0.159	0.139
Social	0.254	0.222	0.316	0.115	0.072	0.473**
Overall Total	0.115	0.373	0.146	0.409*	0.369	0.015

Table 7.2 shows that cognitive engagement strongly correlates with performance in *Frequency Distribution Tables* and *Understanding Integers*, while emotional engagement is

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significantly linked to better outcomes in *Understanding Integers*. Social engagement also shows a notable positive correlation with overall performance (r = 0.473*), underscoring the importance of peer interaction. In contrast, behavioral engagement displayed weak, non-significant links, suggesting that surface-level compliance does little to enhance achievement without deeper thinking or emotional investment.

These findings imply that reciprocal teaching is most effective when it fosters cognitive depth, emotional involvement, and social participation. Zhang & Chen (2023) reported that students who assumed roles such as clarifier or questioner benefited most, as cognitive effort through problem-solving and elaborative dialogue drove academic gains. Similarly, Alkatib & Salameh (2021) emphasized that emotional safety and peer support allowed students to ask questions and correct misconceptions, leading to stronger understanding. Overall, reciprocal teaching works best when it integrates intellectual effort with supportive peer interaction and emotional engagement.

7.3. Level of Performance using Collaborative Learning Strategy.

Level of Engagement	Data collection and sampling	Frequency Distribution Table	Data Presentation	Understanding Integers	Adding and Subtracting Integers	Overall total
Cognitive	0.054	0.007	0.362	0.055	0.211	0.121
Behavioral	0.087	0.095	0.199	0.015	0.294	0.012
Emotional	0.391	0078	0.456*	0.256	0.187	0.123
Social	0.015	0.008	0.479*	0.088	0.112	0.190
Overall Total	0.050	0.023	0.405*	0.073	0.221	0.125

Table 7.3 shows that collaborative learning had significant correlations with emotional engagement (0.456)* and social engagement (0.479)**, indicating that students' emotional involvement and peer interactions were strongly linked to their performance, especially in tasks requiring explanation and visualization. Overall, emotional (0.123) and social (0.190)

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engagement were slightly stronger than cognitive (0.121) and behavioral (0.012), suggesting that collaboration works best when it builds positive group dynamics and shared motivation rather than relying on surface participation. However, weaker correlations in some areas imply that certain math skills may still require more individualized, cognitively focused instruction.

These findings are supported by Park & Kim (2022), who found that students in collaborative settings performed better in retention and conceptual understanding, with emotional resonance reducing math anxiety and enhancing persistence. Similarly, Nguyen & Vo (2023) showed that collaborative groups outperformed competitive and independent groups, reporting higher motivation, enjoyment, and confidence. Both studies emphasized that collaborative learning is most effective when it intentionally fosters emotional connections and peer support alongside academic collaboration.

IV. CONCLUSION

The study revealed that before the use of social learning strategies, students' performance was mostly low to average, with weaknesses in computation and data management. After integrating Peer-to-Peer Teaching, Reciprocal Teaching, and Collaborative Learning, student proficiency improved significantly across topics, with Peer-to-Peer Teaching proving the most effective. These strategies enhanced cognitive, social, and emotional engagement, which were strong predictors of success; while behavioral engagement showed weaker effects. Although most topics improved, "Understanding Integers" showed no significant gains, highlighting the need to align teaching methods with content complexity.

V. RECOMMENDATION

It is recommended that teachers continue applying Peer-to-Peer, Reciprocal, and Collaborative learning strategies across the mathematics curriculum, as they improve performance and engagement. These approaches should be used not only in the areas studied but also in other math topics and grade levels. Teachers are encouraged to strengthen interaction and participation through these strategies, as they effectively enhance mathematical proficiency and create more engaging learning environments.

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