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INFLUENCE OF COLLABORATIVE LEARNING ON STUDENTS' MATHEMATICS ACHIEVEMENT

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Abstract:
Collaborative learning has been interestingly considered by most researchers as an effective strategy in enhancing students' mathematics performance. This research assessed the influence of collaborative learning towards the Grade 7 students' mathematics achievement at a public national high school in Cebu, Philippines, for the school year 2023-2024 using a descriptive correlational research design. There were 141 respondents who answered the questionnaire about their perception towards collaborative learning, and their performance was assessed using their second-quarter grades in Mathematics. The data gathered were treated using frequency count, percentage, weighted mean, and Pearson's r. The results revealed that the respondents have a positive perception towards collaborative learning, and most of them have outstanding mathematics performance. Moreover, there was a weak positive correlation between the respondents' perception towards collaborative learning and their mathematics achievement. The results suggest the important influence of utilizing collaborative learning in math instruction. It is recommended that the educators utilize the strategy in lessons that require critical thinking skills so that students can validate their assumptions on certain mathematical tasks that need analysis.

Keywords: collaborative learning, mathematics achievement, descriptive-correlational design, Grade 7 students

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1. Introduction

Mathematics is a fundamental aspect of human life with widespread real-world applications and a discipline which is present across all educational levels, demanding logical thinking, organization, and demonstration abilities (Darmayanti *et al.*, 2023). The skills gained from studying mathematics, such as problem-solving, analytical thinking, pattern recognition, and spatial reasoning, are crucial for successfully navigating diverse real-world situations and challenges (Peteros, 2024). Mathematics achievement becomes more significant in this data-driven world through understanding numerical data, making informed decisions, and evaluating critically based on mathematical proofs. In the realm of education, mathematics provides a strong foundation for learning and academic success. It is linked to better career opportunities as it opens a wide array of employment doors across industries, including finance, medicine, and research. Truly, mathematics holds a strong driving force in the upliftment of oneself and in shaping the future of humanity (Peconcillo *et al.*, 2020).

Despite the vital importance of mathematics, many students worldwide still find it challenging. Studying mathematics can be difficult, often leading to repeated failures, a lack of interest, and even being passive (Doabler *et al.*, 2022; Finesilver *et al.*, 2022; Rojo *et al.*, 2022). This issue is a significant concern within the education community. To address this problem, teachers, as key education stakeholders, utilize various teaching strategies to improve students' performance in mathematics, making the learning experience easier, more enjoyable, and more meaningful (Peteros *et al.*, 2022).

Despite teachers' efforts in instruction, the Philippines consistently performs poorly in mathematics on global assessments. Since joining the Trends in Mathematics and Science Study (TIMSS) in 1999, the country has remained at the bottom of the rankings. TIMSS assesses the mathematics and science intellectual capacity of grade four or five and grade eight or nine students worldwide. In the 2019 TIMSS, the Philippines ranked last out of 58 countries in both subjects. These consistently low scores indicate that Filipino students are significantly behind in mathematics education (Silangan *et al.*, 2023).

One effective strategy that teachers use to improve students' performance in mathematics is collaborative learning. This educational method engages students in collaborating with their peers to reach common learning objectives. In this approach, students are grouped to facilitate free interaction and collective idea development. Students taught through collaborative learning showed greater improvement in critical thinking compared to those taught through traditional lecturing (Warsah *et al.*, 2021). As a result, this strategy is now widely adopted by teachers to achieve better learning outcomes.

The use of collaborative learning strategy is evidently used in a public high school in Cebu, Philippines. Teachers from this school have observed that utilizing the collaborative learning strategy in teaching mathematics concepts to students can make the learning experience more engaging that can eventually lead to better mathematics performance among students. This observation basically implies that students feel

comfortable when teachers use collaborative learning strategies in their mathematics subject.

It is for this reason that there is a need to study the students' perception towards collaborative learning and how these affect their mathematics achievement. This study aims to assess the influence of collaborative learning on the mathematics achievement of the Grade 7 students at a public high school in Cebu, Philippines, whose teachers utilize collaborative learning approach in teaching mathematics. This study intends to identify the level of perception among students towards collaborative learning and its relationship towards their mathematics performance. Moreover, the expected outcome of the study highlights the significant role of collaborative learning in addressing poor mathematics achievement among students.

2. Purpose of the Study

This research assessed the influence of collaborative learning on the mathematics achievement of the Grade 7 students at a public high school in Cebu, Philippines for the school year 2023-2024. Specifically, this study sought to answer the following objectives:

1) To assess the level of perception of the respondents towards collaborative learning in learning Mathematics,
2) To determine the level of mathematics achievement of the respondents,
3) To test the relationship between the respondents' perception towards collaborative learning and their mathematics achievement.

3. Materials and Methods

This research utilized a descriptive correlational design aimed at exploring relationships between variables and using current information to predict future events. To ensure fairness, representativeness, and equal probability among the population by using simple random sampling. According to Noor *et al.* (2022), this method ensures that every individual has an equal chance of being included in the study, solely based on random selection. A total of 141 respondents participated in answering the survey questionnaire. Table 1 presents the distribution of the respondents.

Table 1: Distribution of the Respondents

Section	**n**	**%**
EBA	29	20.57
EGRR	29	20.57
GUO	28	19.86
HDB	27	19.15
LLA	28	19.86
Total	**141**	**100.00**

The research environment was chosen for its esteemed reputation in promoting interdisciplinary collaboration, providing extensive mentorship opportunities, and

closely aligning with the study's focus on innovative teaching methodologies. The respondents were selected due to their direct relevance to the study, ensuring a diverse representation of learners at a critical stage in their mathematical development. This makes them ideal candidates for examining the effectiveness of various teaching methods. Furthermore, their accessibility within the school for research activities and their potential to offer diverse perspectives enhance the richness and reliability of the study's findings. The researchers utilized a survey questionnaire adopted from Destriana (2018), which assessed the respondents' perceptions of collaborative learning. To evaluate the respondents' mathematics achievement, the researchers used their second-quarter grades, obtained with the help of their adviser. These grades were interpreted according to the Department of Education's standards for proficiency levels. The data were analysed using frequency counts, percentages, weighted means, and Pearson's r.

3. Results and Discussion

This section presents the results, data presentation, and analysis of the data gathered from respondents. This includes the test of the hypothesis of the paired variables.

3.1 Perception of the Respondents towards Collaborative Learning

Table 2: Perception of the Respondents towards Collaborative Learning

S/N	Indicators	WM	Verbal Description
1	Help me understand the materials	4.33	Very Positive
2	Helps students to exchange knowledge, information, and experience	4.26	Very Positive
3	Makes me solve the problem easier	4.35	Very Positive
4	Stimulates critical thinking	4.35	Very Positive
5	Makes me more relaxed in learning	3.83	Positive
6	Provides me with helpful feedback	4.11	Positive
7	Helps me be responsible for myself and the group	4.44	Very Positive
8	Provides me with a better understanding	4.23	Very Positive
9	Improves my communication skills	4.32	Very Positive
10	Improves my performance	4.30	Very Positive
11	Makes me actively participate in the learning process	4.23	Very Positive
12	For me, group work is a fun learning strategy	4.44	Very Positive
13	Collaborative learning makes me have more new friends	4.61	Very Positive
14	Increases my team spirit	4.26	Very Positive
15*	Wastes my time explaining things to others	3.90	Positive
16*	Is difficult for my friends to actively participate in tasks	3.28	Neutral
17	In my opinion, pair/group work should be encouraged/continued	4.40	Very Positive
18	In my opinion, the maximum group size should be four people	3.07	Very Positive
Aggregate Weighted Mean		**4.15**	**Positive**
Legend: 4.21-5.00-Very Positive; 3.41-4.20-Positive; 2.61-3.40-Neutral; 1.81-2.60-Negative; 1.00-1.80-Very Negative. *reverse scoring			

Table 2 shows that the respondents perceive collaborative learning in a positive way. This means that the respondents agree on the statements describing their perception towards collaborative learning. In fact, most of the indicators, specifically 14 out 18 indicators, resulted in a very positive response among the respondents. Similar to a study by Kanika *et al.* (2022), they discovered that it was evident that teamwork positively improves students' academic progress. The findings of the Qureshi *et al.* (2021) study, which suggest that group learning with peers is advantageous for students since it may result in student quality outcomes, can be connected to the perception of the students.

Among the 18 indicators, there are two indicators stating negative statements about collaborative learning. One is indicator 15 that states collaborative learning wastes my time explaining things to others, which reveals that students. For this indicator, respondents answered with a positive response. This means respondents agree on that statement, which shows that even though collaborative learning has proven beneficial to student learning outcomes, it still has limitations. Items marked with "Neutral" remarks in Table 2, particularly "Is difficult for my friends to actively participate in tasks," reflect a critical aspect of collaborative learning. This neutrality underscores the need for further exploration of potential barriers to active engagement in group tasks.

Furthermore, the outcome could be explained by the fact that students who answered the survey believed that group or pair activities should be promoted and carried out. They firmly thought that by working together to study, they could better comprehend the mathematical concepts and teachings, which would improve their critical thinking, communication, and problem-solving abilities. The study's findings also show that they are capable of exchanging ideas and opinions in stimulating group activities, which increased their level of participation in the educational process. In addition to enhancing students' critical thinking abilities, a study by Warsah et al. (2021) on learners' perspectives on collaborative learning (CL) also found that CL benefited students' emotional awareness, learning motivation, cognitive development, and open-mindedness.

3.2 Level of Mathematics Achievement

This section presents the mathematics achievement of the student respondents. It utilizes the second quarter grades of the respondents given by their respective mathematics teachers. Assigning numerical values to mathematical achievement is a crucial component of the educational process, as it provides stakeholders and students with feedback to improve learning. The competencies exhibited by a student in mathematics are referred to as mathematical achievement. Thus, the mathematics achievement of the respondents was ascertained and is shown in Table 3 below.

Table 3: Level of Mathematics Achievement of the Respondents

Level	Numerical Range	f	%
Outstanding	90-100	39	27.66
Very Satisfactory	85-89	38	26.95
Satisfactory	80-84	38	26.95
Fairly Satisfactory	75-79	26	18.44
Did not Meet Expectations	Below 75	0	0.00
Total		**141**	**100.00**
Mean		85.60	
St. Dev.		5.88	

Table 3 shows the level of mathematics achievement of the respondents. There were 39 out 141 students or 27.66 percent of them belonged to the outstanding level, while 38 students or 26.95 percent of them belonged to very satisfactory the same percentage with students having satisfactory level. Furthermore, 26 students or 18.44 percent of them got a level of fairly satisfactory, but none of them failed to meet expectations. The data pertaining to the achievement level in mathematics suggest that, in general, the respondents surpass the fundamental requirements in terms of knowledge, skills, and comprehension. They are able to transfer these requirements through authentic performance tasks with ease and adaptability, especially when it comes to the subject of mathematics. It can be inferred that pupils are performing well and receiving high marks in the relevant topic (Peteros *et al.*, 2021).

The data could be explained by the idea that instructional strategies have an impact on students' mathematical achievement. Collaborative learning is one of the strategies that is discussed and applied in mathematics instruction. According to a previous study by Warsah *et al.* (2021), collaborative learning was seen as one of the elements supporting the growth of the learners' cognitive maturity and ability. According to the findings of Qureshi *et al.* (2021), collaborative learning is a crucial teaching strategy since it motivates students to collaborate and participate, which raises their level of engagement. It can be inferred from comparable results and findings from related studies that collaborative learning helps students achieve more in mathematics.

3.3 Relationship between Perception towards Collaborative Learning in Learning Mathematics and Mathematics Achievement

This section presents the relationship between the respondents' perception towards collaborative learning and their mathematics achievement. It is essential to determine its relationship in order to give a profound understanding of the influence of collaborative learning on their mathematics achievement. The data shown in Table 4 plays a significant role in identifying the relationship between the two mentioned variables. This can assist in determining if the null hypothesis should be rejected or not, which can ultimately result in a sensible conclusion and a useful action plan for the educational setting.

Table 4: Correlation Analysis

Variables	r-value	Strength of Correlation	p – value	Decision	Result
Perception and Mathematics Achievement	0.309***	Weak Positive	0.000	Reject Ho	Significant
*significant at p<0.001 (two-tailed)					

Table 4 reflects the test on the significant relationship between two variables namely, respondents' perception towards collaborative learning and their mathematics achievement. Utilizing the Pearson correlation coefficient (r), the result reveals a p-value of 0.000, which is less than 0.001, suggesting rejection of the null hypothesis. Hence, it can be inferred that there is a significant relationship between the two mentioned variables. The very low p-value signifies a strong statistical relationship between respondents' perception towards collaborative learning and their mathematics achievement, implying that employing collaborative learning in mathematics class can improve mathematics achievement. This statistical analysis can provide salient points to consider in education programs, projects, and activities. Having a comprehensive knowledge of the relationship between these two variables can help address problems related to the mathematics achievements of the students. With an analysis at hand, it serves as a guide for an action plan, allowing educators to employ teaching strategies that fall under the collaborative learning approach.

Previous studies support the notion that high school pupils exposed to collaborative learning techniques had significantly higher achievement in mathematics. According to Olanrewaju (2021), students using collaborative learning techniques achieved better learning outcomes in mathematics than their peers in the study's control group. When teachers introduce kids to collaborative learning in the classroom, this helps them understand the benefits of it even more. In contrast to the conventional approach, collaborative learning improved students' achievement in mathematics.

Moreover, the test of significant relationship using the Pearson product-moment correlation has shown an essential connection between respondents' perception towards collaborative learning and mathematics achievement. The statistical values obtained and shown in the table are strong indicators of how collaborative learning can bring better learning outcomes, specifically in the field of mathematics. The findings could be of great help in uplifting the educational standards by mandating the use of appropriate teaching approaches in the curriculum, especially in the improvement of students' mathematics achievement.

4. Conclusion

The research evaluated the impact of collaborative learning on students' mathematical achievement in a public high school. The findings indicated that collaborative learning significantly and contextually enhances students' success in mathematics. Students showed positive views on collaborative learning, suggesting that they consider this

method helpful for both their academic comprehension and their social involvement in math classes. Conversely, the levels of students' mathematics achievement indicate that the learning environment was largely favorable to success. The existence of collaborative learning methods seems to have fostered an atmosphere where students were able to actively participate in mathematical activities, express their thoughts, and resolve misunderstandings through discussions with peers. These processes hold significant importance in mathematics, a discipline frequently viewed as challenging and abstract, since cooperative activities enable students to build understanding together instead of depending solely on teacher-led explanations.

Furthermore, the correlation between students' views on collaborative learning and their success in mathematics highlights the instructional importance of this method. Though collaborative learning may not act as a sole or primary influence on achievement, its favorable connection to performance indicates that students who are more open to and involved in collaborative tasks often experience academic advantages. This emphasizes collaborative learning as a beneficial approach that boosts motivation, involvement, and conceptual comprehension, which consequently leads to improved learning results. Thus, collaborative learning positively impacts students' mathematics performance by establishing a learning atmosphere that is cognitively stimulating, socially encouraging, and culturally attuned. Its efficacy is found not only in enhancing academic achievement but also in nurturing positive learning experiences that motivate students to engage actively and confidently in mathematics. Consequently, collaborative learning must be maintained and carefully incorporated into mathematics teaching as part of a larger initiative to improve the quality and significance of education in Philippine schools.

Conflict of Interest Statement
The authors declare no conflicts of interest.

About the Author(s)
Christilyn F. Casinillo holds a Bachelor of Science in Education (BSEd) major in Mathematics and a Master's degree in Teaching Mathematics, which demonstrates her commitment to broaden her knowledge and refining her teaching methodology. She is currently a Teacher III at Tulang Integrated School, where she teaches mathematics and

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Jackferr B. Lacandula holds a Master of Arts in Education with a specialization in Teaching Mathematics and is currently a Mathematics teacher. His professional interests focus on developing students' holistic capabilities by providing diverse and meaningful learning opportunities in the classroom. He is committed to fostering students' appreciation of Mathematics and helping them recognize its relevance and importance in their daily lives. To support active learning and deeper understanding, he integrates the Building Thinking Classroom approach as an instructional strategy to promote academic conversations, collaborative problem-solving, and critical thinking. His instructional practice emphasizes learner-centered environments that encourage engagement, conceptual understanding, and a positive disposition toward Mathematics.

Wendelyn M. Zanoria holds a Master of Arts in Education with a specialization in Teaching Mathematics and is currently a Mathematics and English Language teacher. Her academic and professional interests focus on identifying and addressing students' learning barriers through the integration of mathematical and language-based instructional approaches. Her work emphasizes evidence-based and learner-centered pedagogical strategies that support diverse learners, enhance mathematical understanding, and strengthen language proficiency in academic contexts. Central to her scholarly engagement is the examination of instructional practices that improve student engagement, learning outcomes, and instructional efficiency through interdisciplinary teaching in mathematics and language education.

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