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Elevating Math Education: Improving Elementary Learners' Performance through Collaborative Learning Approach

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ABSTRACT

This study investigates the effectiveness of the collaborative learning approach in enhancing the performance of learners in Grade III Mathematics. Recognizing the challenges students face in understanding mathematical concepts, the research was conducted to determine whether structured group learning activities can significantly improve academic outcomes. A quasi-experimental design was used involving a single group of 27 learners. Pretest and posttest data were collected and analyzed using a paired sample t-test. Collaborative strategies such as small group discussions, group problem-solving, peer mentoring, gamification, and shared reflections were integrated into daily lessons over a period of four weeks. Results showed a significant increase in mean scores from 11.33 (pretest) to 18.37 (posttest), indicating the effectiveness of collaborative learning in enhancing learners' mathematical abilities. The findings suggest that collaborative learning not only boosts academic performance but also fosters a supportive learning environment that encourages critical thinking and active involvement. Additionally, learners demonstrated enhanced participation, motivation, and confidence in solving mathematical problems. These results suggest that collaborative learning is an effective pedagogical tool for elevating math education at the elementary level. This study recommends the integration of collaborative methods in Mathematics instruction to address individual learning gaps and promote collective academic growth.

Keywords: elementary learners, collaborative learning approach, small group, peer mentoring, gamification

INTRODUCTION

Improving the performance of the learners in Mathematics is a big challenge to teachers. Despite the efforts to improve Mathematics education, many students continue to struggle with understanding mathematical concepts and applying them to real-life problems. Traditional teacher-centered approaches often limit students' opportunities for active participation and critical thinking, which are essential for mastering mathematical skills. As educational paradigms shift toward more student-centered learning, collaborative learning has emerged as promising alternatives to improve learning outcomes. In the study conducted by Uya (2023), it was found out that students engaged in collaborative learning consistently outperformed those in traditional, expository classrooms in terms of Mathematical achievement. The root of the problem often lies in traditional teaching methods that emphasize individual work, memorization of formulas, and teacher-centered instruction, which may not effectively address the diverse learning needs and styles of young learners.

Internationally, research has shown that collaborative learning strategies can significantly enhance learners' understanding and achievement in mathematics. According to Johnson and Johnson (2019), collaborative learning promotes positive interdependence, individual accountability, and interpersonal skills, leading to better cognitive and social outcomes among students. Similarly, Gillies (2016) emphasized that students engaged in cooperative learning environments tend to develop higher-level thinking skills and perform better academically compared to those in traditional settings.

Relatively, learners' performance in mathematics remains a pressing concern in the Philippine context. Based on the 2019 Trends in International Mathematics and Science Study (TIMSS), Filipino students scored significantly lower than the international average in mathematics, ranking among the lowest participating countries (IEA, 2020). Additionally, the Department of Education (DepEd) has acknowledged the urgent need to improve mathematics instruction in the basic education curriculum. Studies such as that of Navarro and Santos (2021) recommend the adoption of more learner-centered approaches, including collaborative learning, to address the widening gaps in math performance and to align with 21st-century learning competencies.

While numerous studies have explored proficiency in Mathematics among young learners, there remains a gap in understanding the specific factors that affect proficiency in Mathematics. In Santo Tomas West District, particularly in San Isidro Elementary School, most of the students in Grade 3 got very low score in periodical exams in the school year 2024-2025. Learners often characterized by low performance, limited engagement, and negative attitudes during the teaching-learning process in the classroom. Questions remain regarding how collaborative strategies can be tailored to local classrooms and how they influence learner outcomes in diverse and resource-constrained settings.

REVIEW OF RELATED LITERATURE

Collaborative learning is an educational approach to teaching and learning that involves groups of students working together to solve problem, complete a task or create a product. In addition, collaborative learning is a teaching method that is carried out by more than two learners, the resources are shared in certain times, different abilities and skills of the learners are required during the activities completion in order to achieve certain goals or learning objectives through interactions, exchanges experiences or changes of roles within the group in which all of these will impacted the achievement of the learners (Lim et al., 2023). Shimazoe and Aldrich (2010) provides several benefits on the use of collaborative learning method for learners.

This strategy generates conversation, discussion debate and relationship-building among the students in the group and encouraging them to work collectively (Neo, 2005). According to Johnson and Johnson (2023), the elements that are found in collaboratives learning include positive interdependence, individual accountability, promote interaction, social skills ang group processing. In other words, the members within the group must perceive their goal to be related for them to work together as achieve common goal. The individual accountability element suggests that individuals will be more motivated to contribute. As such, if the learner within the team is made to feel that he or she is needed will be more inclined and motivated to cooperate with the rest of the group member. Also increased individual accountability tends to increase the positive independence among group members. International studies have shown the effectiveness of collaborative learning in Mathematics.

For instance, the study of Boaler (2008) found out that students exposed to collaborative, inquiry-based math instruction in the United Kingdom developed deeper conceptual understanding and performed better in assessments compared to those taught traditionally. Similarly, Johnson et al (2014) found that cooperative learning methods significantly improved students' problem-solving abilities and attitudes toward math.

Collaborative learning is a teaching method that is carried out by more than two learners, the resources are shared in certain times, different abilities and skills of the learners are required during the activities completion in order to achieve certain goals or learning objectives through interactions, exchanges of experiences or changes of roles within the group in which all of these will impacted the achievement of the learners (Lim et al., 2023) provides several benefits on the use of collaborative learning method for students.

First, collaborative learning promotes deep learning of materials. Second, students achieve better grades in collaborative learning compared to competitive or individual learning. Third, students learn social skills and civic values. Fourth, students learn higher-order, critical thinking skills. Fifth, cooperative learning promotes personal growth. Finally, students develop positive attitudes toward autonomous learning. It is based in the idea that students learn best by interacting with each other and sharing their knowledge and ideas (Shi et al., 2020). As a result, group members who work in collaborative groups outperform students who work by themselves or in a competition with each other (as seen in competitive conventional classrooms) (Sun et al., 2021).

Teacher-centered methods such as lecturing, demonstrations, memorizing, reviewing, and questioning are often used by many instructors. According to Chin (2007), these approaches do not stimulate or improve students' understanding of science. Student-centered learning methods such as collaborative learning could be used in shifting the focus of activity from teacher to the learner. Collaborative learning is based on the constructivist model in which students construct rather than receive or assimilate knowledge (Puntambekar, 2006).

Constructivist learning models also require intellectual effort by students and aids in the retention of knowledge and generate interest in science. The role of the teacher in the student-centered learning is to facilitate the students' learning by providing a framework of activities for the students to complete. Constructivists believe that for higher level of cognition to occur, students must build on their own knowledge through activities that engage them in active learning (Cooperstein et al., 2004).

Effective learning takes place when students take stock of what they already know and then move beyond it. If students construct their own framework scheme through experimenting, they are more likely to retain the facts they learn, specifically for this study in chemistry. Despite the application of redox reaction in technological development and everyday life, both students and teachers of chemistry consider the concept difficult (Udu, 2018). Studies have shown that the performance of students in redox reaction in most West Africa countries has generally and consistently been poor over the years (Adu-Gyamfi & Ampiah, 2019).

According to Acker and Armenti (2007), the instructional method which is right for a particular lesson depends on many factors. Among these are the age and developmental levels of the students, what the students already know and what they need to know to succeed in a lesson, the subject matter content, the objective of the lesson, and class size. Other factors are time, space, materials, resources, and the physical setting. A more difficult problem is to select an instructional method that best suits one's particular teaching style and the lesson to be taught. Flores (2016) suggested that resources that assist teachers teach better are typically a lesson plan or practical activity that involves learning and acquisition of skills.

Furthermore, students' working in groups is another way the teacher can organize a better constructivist lesson. Many educators seek to apply the strategies that help students collaborating to complete course work (Reigeluth, 2009). Reigeluth (2019) explained that active or participatory learning by the students within the classroom environment has been recognized as an effective, efficient, and superior instructional technique. Yet, only a few teachers in basic and senior high schools in Ghana employ this pedagogical strategy (Akyeampong & Lewin, 2002).

Collaborative or peer learning is one of the most widely discussed teaching methods according to Marjan and Seyed (2012). According to researchers (e.g., Darling-Hammond, 2006), collaborating in learning allows students in smaller groups to work on the same task; talk among themselves and to the viewpoints of one another during discussions or assignment. Evidence from Puntambekar's (2006) research shows that collaborative learning approaches increase opportunities for learners to practice concepts they have been taught and provide opportunities for learners to be problem solvers rather than information receivers. It also provides opportunities for meaningful interactions between peers and teachers.

According to Johnson and Johnson (2009), small group learning is supported by social interdependence theory, which posits that cooperation leads to greater achievement, more positive relationships, and improved psychological health than competitive or individualistic learning. Studies consistently show that small group work can enhance academic achievement. Lou et al. (1996) conducted a meta-analysis and found that students working in small groups outperform those working alone, particularly in problem-solving and conceptual understanding tasks.

Small group learning helps develop communication, collaboration, and conflict-resolution skills, which are essential for future careers. Laal and Ghodsi (2012) emphasized that cooperative small groups foster teamwork and interpersonal skills, especially when roles and tasks are clearly assigned.

Moreover, collaborative settings promote positive attitudes toward mathematics and reduce math anxiety (Zakaria et al., 2013). Students learn not only from teachers but also from diverse peer perspectives, which broadens their problem-solving strategies. In terms of achievement, studies have consistently indicated that collaborative learning improves student performance, particularly in complex problem-solving tasks. A meta-analysis by Johnson and Johnson (2009) highlighted that cooperative learning methods in mathematics led to higher test scores and better retention of mathematical concepts compared to traditional individual learning. Additionally, collaborative learning has been linked to increased student motivation and engagement, as students feel more connected to the learning process and to their peers. This increased motivation is particularly important in mathematics, a subject where many students face anxiety and disengagement.

In addition, collaborative learning environments can lead to complex classroom dynamics that require careful management. Managing student behavior and ensuring meaningful engagement during group work is a common challenge. Collaborative settings can lead to off-task behavior, dominance by certain students, or the exclusion of quieter peers (Cohen & Lotan, 2014).

Furthermore, the structure of mathematics curricula in many educational systems is dense and highly standardized, leaving little flexibility for collaborative learning activities. Teachers may feel pressured to "cover the syllabus" quickly in preparation for standardized testing, leading them to prioritize direct instruction over interactive learning (Zhou & Brown, 2015). As a result, collaborative strategies, which often require more instructional time, are sidelined despite their long-term benefits for comprehension and retention. In general, mathematics teachers start lessons with dictating formulae to solve the questions (Mirza & Iqbal, 2014). Students viewed mathematics in abstract form Contribution to the literature.

This study provides robust empirical evidence supporting the positive impact of collaborative learning on mathematics achievement among elementary (grade six) students.

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Teaching collaborative skills explicitly. Students often need direct instruction on how to work effectively in groups. Skills such as active listening, turn-taking, giving constructive feedback, and reaching consensus must be modeled and practiced. Incorporating group norms and role assignments (e.g., facilitator, recorder, checker) helps clarify expectations and foster accountability (Gillies, 2016).

Teachers play a crucial role in scaffolding collaborative learning. This includes providing guiding questions, prompts, checklists, and structured worksheets that support students' mathematical reasoning and interactions. Vygotsky's concept of the zone of proximal development suggests that with appropriate support, students can perform tasks collaboratively that they may not be able to complete independently (Vygotsky, 1978).

Creating a supportive classroom culture. A classroom culture that values cooperation over competition is essential. Teachers can promote a growth mindset, where mistakes are viewed as learning opportunities, and success is a shared goal. Recognizing and rewarding group effort and mutual support helps foster trust and positive interdependence (Slavin, 1995).
Collaborative learning can transform mathematics instruction when implemented with intentionality and structure. By designing meaningful tasks, cultivating collaborative skills, and fostering inclusive classroom environments, educators can enhance students' mathematical understanding and engagement. Successful implementation also requires ongoing assessment, adaptive teaching, and professional growth opportunities for teachers

Statement of the Problem
This study sought to investigate to the following questions:
1. What is the competency level of the students in the pretest?
2. What is the competency level of the students in the posttest?
3. Is there a significant difference between the pretest and posttest scores of the experimental group?

Null Hypothesis
The hypothesis was formulated and tested at .05 level of significance.
HO. There is no significant difference between the pretest and posttest of the experimental group.

METHODS

Research Design
The study employed the quantitative quasi-experimental single group pretest posttest research design in gathering the data. Quasi experimental design was proposed by Campbell (1968). According to him a quasi-experimental research design is that looks a bit like an experimental design but lacks the key ingredient- random assignment. The research design was a single group quasi-experimental pre-test-posttest design wherein the group was given pretests in the beginning and posttests at the end of every period under consideration (Padua, 2000). The data come from the results of the pretests and posttests before and after the series of treatment to the experimental group.

Research Locale
This quasi-experimental study was conducted at San Isidro Elementary School in , Purok 16, Feeder Road 7, Barangay Tibal-og, Santo Tomas, Davao del Norte in the Philippines within Davao Region of Mindanao. Purok 16, Sitio San Isidro is a small rural area of Barangay Tibal-og with a distance of approximately 6 kilometers from población. It is bounded on the North by Barangay Mamacao, Kapalong, Davao del Norte and on the west by barrio San Jose, Santo Tomas, Davao del Norte. The land area is about two hundred hectares of residential and most of agricultural land devoted to rice fields, root crops, fruit trees and vegetables. It is populated by people mostly engaged in farming. Presently, San Isidro Elementary School is managed by a School Head, Glenn B. Timbal, with eight national paid teachers. The school offers equal learning opportunities to its learners from Kindergarten to Grade VI.

Research Locale

The subjects of this study involved 27 Grade 3 learners from San Isidro Elementary School, Tibal-og Santo Tomas, Davao del Norte during the school year 2025-2026. Inclusion criteria required that research subjects were currently enrolled in Grade 3, have parental or guardian consent, and demonstrate basic reading and communication skills necessary for group work and collaboration. Exclusion criteria included students with diagnosed cognitive or behavioral disorders that may hinder participation in group-based learning activities, those receiving one-on-one special education services for mathematics, or students who have already participated in similar collaborative programs. Participation was voluntary, and students may withdraw at any time without academic penalty or loss of access to regular instruction.

Research Instrument

A 30-item researcher-made test aligned in the Most Essential Learning Competencies (MELCs) defined by the Department of Education in the Philippines (DepEd) as the indispensable skills and knowledge that students need to acquire during the teaching-learning process, validated by experts, tried out through a pilot testing before using it in a study used for both pre- and post-tests. A Table of Specifications (TOS) was also prepared so that the items of the test can be distributed to the different learning skills. The questionnaire was a multiple-choice type of test with four choices for each item and consisting of 30 items with 60% easy questions, 30% average questions, and 10% difficult questions. This test served as the pretests and posttests of the research study. The researcher also developed lesson plans incorporating the collaborative learning approach which, serves as the intervention plan for the experimental group.

Data Gathering Procedure

The first step that the researcher done was to ask certification from the Ethics Review Committee to secure endorsement letter addressed to the school's division superintendent. Once approved, the researcher wrote a letter of request and permission to the Office of the Schools Division Superintendent of Davao de Norte to allow her to conduct the study. After the approval, the researcher submitted the approved letter as well as the permission letter to the school principal. In like manner, the researcher informed the subjects for study who were chosen for the quasi-experimental study. Furthermore, the researcher observed proper ethical standards on the conduct of the study and the names of the subjects were not indicated and any important matters were kept with utmost confidentiality. Then, proceed to conduct the study.

A written permission sought from the School Principal of San Isidro Elementary School, Santo Tomas West District for the pilot testing of the validated pre-test and posttest material. Recommendations and revisions were noted for the improvement. Administration of the Instrument. Since the pre-test, the researcher gathered the learners' performance in mathematics. Then, the researcher made lesson plans employing during the conduct of intervention phase of the experimental group. After the administration of lesson in four-week period, post-test was conducted with the same instrument used in the pre-test.

Since the pretest, the researcher gathered the student's performance in Mathematics. Then, the researcher made lesson plans with collaborative learning strategies employed during the conduct of intervention phase of the experimental group. After the administration of lesson, posttest was conducted with the same instrument used in the pretest.

Statistical Treatment of Data

The data were organized and collated. The following statistical tests were employed to make accurate analysis and interpretation of the different data gathered in this research.

Mean ($\bar{x}$). This was used was used to determine the average performance scores of the Grade 3 learners in experimental group before and after the implementation of the collaborative learning approach. It provides a central measure that reflects the overall performance level of the group.

Standard Deviation (SD). This was used to measure the variability or dispersion of learners' scores from the mean. A lower standard deviation indicates that the scores are closely clustered around the mean, while a higher standard deviation signifies greater variability in performance.

t-test for Independent Samples. This was used to determine whether there was a statistically significant difference between the mean scores of the experimental group (collaborative learning approach) after the intervention. This test was appropriate for assessing the effectiveness of the collaborative learning strategy on mathematics performance.

The level of significance was set at 0.05. If the computed p-value was less than or equal to 0.05, the null hypothesis was rejected, indicating a significant difference between the groups.

Ethical Consideration

In any research undertaking, be it quantitative or qualitative, it always emphasized that our studies must always have to be guided with the following ethical principles.

Social Value. The results of this study were revealed valuable information that guide public elementary school principals, school heads, and the school community in improving organizational commitment by addressing issues related to school heads' practices and work-life balance. With the results of the study, school heads will become aware of the need to devise ways to manage their practices and work-life balance in ways that would enhance their organizational commitment while maintaining personal well-being. The administration may also realize the need to initiate strategic planning for supporting school heads. Further, this study allowed school heads to identify specific dimensions of their practices and work-life balance that they could focus on improving. The results of this study could be shared with the Department of Education and stakeholders through research conferences, meetings, and other formal gatherings. Additionally, the Department of Education will be given a copy of this manuscript, which could be used by future researchers as a reference for forthcoming research works.

Informed Consent. School heads at public elementary schools were asked to consent by signing an informed consent form. The researcher first sent a letter to the principals of the schools outlining the goals of the study and the potential participants, along with a letter of approval from the superintendent of the school division to carry out the research. Informed consent was given to the subjects. The requirements, the purposes for which the data were used, and the possible outcomes were fully disclosed to the subjects. The subjects were required to sign a written informed consent that was offered to them in order to have their full consent. They were given the ability to ask questions and decline if necessary whenever they had concerns while taking part in the research procedure. The researcher indicated the desire to perform the research with informed consent so that subject is fully mindful of the objective of the study. Lastly, the respondents were enlightened that the findings of the study were kept private in order to guard and preserve their confidentiality, self-esteem, welfare, and autonomy.

Vulnerability of the Research Subject. The choice of whether to participate in the study was the choice of the subjects of the study. If the subjects of the study feel that the questions were too personal, they were not compelled or tricked into giving an answer. The respondents have the option to leave the study at any time they feel exposed or emotionally affected by its results, and the researcher respected their decision. At the time of recruitment, they voluntarily and expressly consented in writing to participate in the data collection process. The information gathered for this study was only used to produce conclusions regarding the issues under investigation. The data gathered in this process were used for any other purposes. The researcher established rapport and confidence to make the respondents feel at ease, safe, and more secure.

Risks, Benefits, and Safety. By ensuring that every respondent was well-cared for and safe from harm, the researcher ensured the respondents' well-being. By giving them a code rather than their identities, their protection was ensured. Given that the data collection is done onsite via face-to-face administration of survey questionnaires, the researcher will guarantee the respondents' safety during the course of this study by ensuring their physical environment is conducive and guarded. The area where the study was conducted have enough room, good ventilation, and the right kind of lighting. Risks were reduced to the extent that the researcher ensures that survey participants fill out questionnaires in environments that are secured for them. The findings were disclosed to the pertinent institutions out of a sense of responsibility and openness on the part of the researcher. After the study was over, the results were shared with the schools to inform them of the research findings. Moreover, the time given by the respondents in the conduct of the study was reciprocated, as they were given token of appreciation as a sign of benevolence for helping the researcher conduct the study.

Privacy and Confidentiality of Information: The researcher will abide by Republic Act 10173, or the Data Privacy Act of 2012, in which the responses and identities of the respondents will not be disclosed to anybody, in consonance with their fundamental human rights to privacy, confidentiality, and correspondence. By all means, the researcher will protect their privacy by ensuring that there are no exposed records of the respondents. The researcher will make sure that nothing is washed and that it all remains private. To safeguard the identities of the schools, the names of the schools will not be included. In order to ensure the privacy of the subjects of the study, they will be represented by codes, so no one will discover their identity except for the researcher. Moreover, the information gathered will be electronically saved, and any hard copies of the collected data will be kept safely in an area that is not accessible to other people.

Justice. No other person or group will be required to subsidize the expenses spent during the study process because this research is exclusively the responsibility of the researcher. In the conduct of the study, the succeeding inclusion and exclusion criteria for the respondents will be reflected. First, the subjects of this study will be currently serving as school heads in public elementary schools. Second, the schools and the school heads belonging to District II of Davao de del Norte

will have the willingness to take part in the study. Third, this study will exclude teachers and principals, and those working in educational institutions belonging to other districts outside District II of Davao del Norte, as well as private elementary school heads. The targeted subjects of the study will be given the assurance that the investigation is done appropriately in every way. The researcher will make sure that respondents understand their responsibility to answer survey questionnaires in an open, truthful, and honest manner. The researcher will give all respondents mementos of appreciation for their significant contribution to this study as remuneration for the time spent collecting data. Additionally, in order to respect the respondents' shared time, the researcher will provide them the opportunity to read their responses and verify their validity.

Transparency. At all times, fabrication and misrepresentation of someone else's work as his or her own will be avoided by the researcher. Any type of communication in relation to the study will be done with trust and transparency. To safeguard the welfare of the respondents, the researcher will properly implement the methods that are utilized in the study. All the needed papers that support data analysis will be included. Further, the researcher will share the nature and objective of the study and the methods that are used. The subjects of the study will be assured that they would be able to access the results of the study whenever they wish to. The results, particularly the information transparency, will be thoroughly addressed. Finally, the researcher will outline the scope of her engagement as well as how she remains impartial while analyzing the data and presenting the results of the study.

DISCUSSION OF RESULTS

Competency Level of the Pretest Scores of the Group

Table 1: Pretest Scores of Experimental Group

Pretest	Number of Pupils	Mean	Class Proficiency	Competency Level
Experimental Group	27	11.33	37.77	Did not meet the expectations

As shown in Table 1, the pretest on Mathematics 3, consisting 30-item for experimental group 27 students has a mean of 11.33 with a class proficiency of 37.77%, the competency level of the students in pre-test did not meet expectation.

Competency Level of the Posttest Scores of the Group.

Table 2: Posttest Performance of Experimental Group

Posttest	Number of Pupils	Mean	Class Proficiency	Competency Level
Experimental Group	27	18.37	61.23	Did not meet the expectations

Based on the data above, we can see that the data provided shows the posttest results in terms of mean score and class proficiency. The mean of Experimental Group is 18.37. The mean percentage of 61.23% reflects a significant improvement compared to the pre-test result of 37.77%. Based on DepEd's competency descriptors, this performance level suggests learners moved from the beginning level to the developing level of competency, we also calculated the class proficiency for the group using the formula: Class proficiency = (mean/HPS) X 100%, where HPS is the highest possible score, which in this case is 27. The data suggests that the experimental intervention had a positive effect of the students' posttest scores and competency level. Learners demonstrated improved understanding of mathematical concepts such as operations, problem-solving, and critical reasoning. The increase in scores indicates that the collaborative learning strategy promoted active engagement, peer teaching, and more confidence in answering math tasks.

Null Hypothesis

Table 3: Pretest and Posttest of the Experimental Group

	Mean	t-value	p-value	Remarks
Pretest	**37.78**	**8.63**	**0.00000000417**	**Reject Ho**
Posttest	**61.23**			

Based on the statistical analysis, the computed p-value was less than the standard level of significance (0.05), leading to the rejection of the null hypothesis, which stated that there is no significant difference in learners' performance before and after the intervention.

This result strongly suggests that the collaborative learning approach is effective in enhancing students' mathematical understanding and problem-solving skills. The improvement in post-test scores indicates that when students work together—sharing ideas, discussing strategies, and supporting one another—they are more likely to grasp mathematical concepts and retain information better.

The success of this approach aligns with both national and international findings that emphasize the value of learner-centered and interactive teaching strategies. Therefore, the study supports the integration of collaborative learning into daily instructional practices in mathematics to foster better academic outcomes among elementary learners.

CONCLUSIONS

The findings of this study revealed that there was a significant improvement in the Mathematics performance of students after the implementation of the intervention. The average score increased in the posttest against the pretest that there indicating a substantial gain in learner competency. The paired sample t-test confirmed that this difference was statistically significant, providing strong evidence that the applied teaching strategy had a positive effect on student achievement. These results emphasize the importance of using innovative and targeted instructional methods to address learning gaps and support academic growth, particularly in foundational subjects such as mathematics. It can be concluded that the collaborative learning approach is an effective strategy in improving students' performance in mathematics. The significant increase in test scores demonstrates that when students work together, they gain a deeper understanding of mathematical concepts and develop essential interpersonal skills.

REFERENCES

[1] Acker, S., & Armenti, C. (2007). Sleepless in academia. Gender and Education, 19(1), 61–77. **https://doi.org/10.1080/09540250601087725**
[2] Adu-Gyamfi, K., Ampiah, J. G., & Agyei, D. D. (2019). Participatory teaching and learning approach: A framework for teaching redox reactions at high school level.
[3] Ahmad, M., & Dogar, A. H. (2023). Effect of Collaborative Learning on Conceptual Understanding ability in Mathematics among 5th Grade Neglected Children. Annals of Human and Social Sciences, 4(2), 205–213. **https://doi.org/10.35484/ahss.2023(4-II)19**
[4] Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability, 21(1), 5–31. **https://doi.org/10.1007/s11092-008-9068-5**
[5] Boaler, J., Brown, K., LaMar, T., Leshin, M., & Selbach-Allen, M. (2022). Infusing mindset through mathematical problem solving and collaboration: Studying the impact of a short college intervention. Education Sciences, 12(10), 694. **https://doi.org/10.3390/educsci12100694**
[6] Campbell, T.G., Yeo, S. Student noticing of collaborative practices: exploring how college students notice during small group interactions in math. Educ Stud Math 113, 405–423 (2023). **https://doi.org/10.1007/s10649-023-10206-3**
[7] Cohen, E. G., & Lotan, R. A. (2014). Designing groupwork: Strategies for the heterogeneous classroom (3rd ed.). Teachers College Press.
[8] Comparative Evaluation of Online and In-Class Student Team Presentations. (2017). Journal of University Teaching and Learning Practice, 14(3). **https://doi.org/10.53761/1.14.3.3**
[9] Cooperstein et al (2004); Beyond active learning: a constructivist approach to learning. Reference Services Review 1 June 2004; 32 (2): 141–148. https://doi.org/10.1108/00907320410537658
[10] Cureus. (2024). From Passive Listeners to Active Learners: Changing Student Preferences in Small Group Learning for the MBBS Curriculum. **https://pmc.ncbi.nlm.nih.gov/articles/PMC11625455/**
[11] Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification". Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, 9–15. **https://doi.org/10.1145/2181037.2181040**
[12] Elevate K-12. (n.d.). What Are the Biggest Benefits of Small-Group Instruction? https://www.elevatek12.com/blog/elevate-in-action/benefits-of-small-group-instruction/
[13] [12]. Fernández-Robles, B., Fraga-Varela, F., Vila-Couñago, E., & Martínez-Piñeiro, E. (2021). The impact of serious games in mathematics fluency: A study in Primary Education. Comunicar, 29(69), 115–125. **https://doi.org/10.3916/C69-2021-10**

[14] Freeman, R., Millard, L., Brand, S., & Chapman, P. (2013). Student academic partners: student employment for collaborative learning and teaching development. Innovations in Education and Teaching International, 51(3), 233–243.**https://doi.org/10.1080/14703297.2013.778064**

[15] Genc, M. & Erbas, A. K. (2019). Secondary Mathematics Teachers' Conceptions of Mathematical Literacy. International Journal of Education in Mathematics, Science and Technology (IJEMST), 7(3), 222-237

[16] Gillies, R. M. (2016). Cooperative learning: Review of research and practice. Australian Journal of Teacher Education, 41(3), 39–54. **https://doi.org/10.14221/ajte.2016v41n3.3**

[17] Hajovsky, D. B., Oyen, K. A., Chesnut, S. R., & Curtin, S. J. (2020). Teacher–student relationship quality and math achievement: The mediating role of teacher self- efficacy. Psychology in the Schools, 57(1), 111-134. **https://doi.org/10.1002/pits.22322**

[18] Yueh-Min Huang, Yi-Wen Liao, Shu-Hsien Huang, & Hsin-Chin Chen. (2014). Jigsaw-based Cooperative Learning Approach to Improve Learning Outcomes for Mobile Situated Learning. Journal of Educational Technology & Society, 17(1), 128–140. **http://www.jstor.org/stable/jeductechsoci.17.1.128**

[19] Ibañez, Edwin D. and Pentang, Jupeth, Socio-Constructivist Learning and Teacher Education Students' Conceptual Understanding and Attitude toward Fractions (April 4, 2021). Indonesian Research Journal in Education, Vol. 5, No. 1, June, 2021, Available at SSRN: **https://ssrn.com/abstract=3974721**

[20] Ibáñez, M. B., Di-Serio, Á., & Delgado-Kloos, C. (2014). Gamification for engaging computer science students in learning activities: A case study. IEEE Transactions on Learning Technologies, 7(3), 291–301. **https://doi.org/10.1109/TLT.2014.2329293**

[21] Johnson, D. W., & Johnson, R. T. (1999). Learning together and alone: Cooperative, competitive, and individualistic learning (5th ed.). Allyn & Bacon.

[22] Kwame EL, Samuel A. Cooperative learning strategy and students' performance in mathematics in junior high school in Hohoe municipality, Ghana. American Journal of Educational Research. 2020;8(9). **HTTPS://doi:10.1261/education-8-9-11**.

[23] Kellem, R. O., Cacciatore, G., & Osborne, K. (2019). Using an augmented reality–basedteaching strategy to teach mathematics to secondary students with disabilities. Career Development and Transition for Exceptional Individuals, 42(4), 253-258.

[24] Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. Procedia - Social and Behavioral Sciences, 31, 486–490. **https://doi.org/10.1016/j.sbspro.2011.12.091**

[25] Lee, H. J. (2022). A Study on Teaching and Learning Methods & Teaching Strategies in Mathematics for Late-Adult Learners: Focusing on the National Curriculum. Journal of Problem-Based Learning, 9(2), 101-109.

[26] Liggett, R. S. (2017). The impact of use of manipulatives on the math scores of grade 2students. Brock Education: A Journal of Educational Research and Practice, 26(2), 87-101.**https://doi.org/10.26522/brocked.v26i2.607**

[27] Lim, R. B. T., Tan, C. G. L., Voo, K., Lee, Y. L., & Teng, C. W. C. (2024). Student perspectives on interdisciplinary learning in public health education: insights from a mixed-methods study. Frontiers in Public Health, 12, 1516525.

[28] Lotan, R. A. (2003). Group-worthy tasks. Educational Leadership, 61(1), 72–75.

[29] Lou, Y., & Abrami, P. C. (2001). Small Group and Individual Learning with Technology: A Meta-Analysis. Review of Educational Research. **https://doi.org/10.3102/00346543071003449**

[30] Mirza, M. S., & Iqbal, M. Z. (2014). Impact of Collaborative Teaching (CT) on MathematicsStudents' Achievement in Pakistan. Journal of Research & Reflections in Education (JRRE), 8(1).

[31] Puntambekar, S. (2006). Analyzing collaborative interactions: Divergence, shared understanding and construction of knowledge. Computers & education, 47(3), 332-351. **https://doi.org/10.1016/j.compedu.2004.10.012**

[32] Piaget, J. (1952). The origins of intelligence in children. Norton.

[33] ResearchGate. (2023). The Effectiveness of the Small Group Discussion Learning Model in Improving Critical ThinkingSkills.https://www.researchgate.net/publication/390220372_The_Effectiveness_of_the_Small_Group_Discussion_Learning_Model_in_Improving_Critical_Thinking_Skills

[34] Rehman, N., Huang, X., & Mahmood, A. (2025). Enhancing mathematical problem-solving and 21st-Century skills through PjBL: a structural Equation Modelling approach. Educational Studies, 1-https://doi.org/10.21649/jspark.v3i3.731

[35] Roschelle, J., Pea, R., Hoadley, C., Gordin, D., & Means, B. (2000). Changing how and what children learn in school with computer-based technologies. The Future of Children, 10(2), 76–101.

[36] Roseth, C. J., Johnson, D. W., & Johnson, R. T. (2008). Psychological Bulletin, 134(2), 223–246.

[37] Saqr, M., Fors, U. & Tedre, M. How the study of online collaborative learning can guide teachers and predict students' performance in a medical course. BMC Med Educ 18, 24 (2018). **https://doi.org/10.1186/s12909-018-1126-1**

[38] W. Shi, Q. Zhou and X. Han, "What Makes Good Blended Collaborative Learning: A Case Study," 2022 Eleventh International Conference of Educational Innovation through Technology (EITT), New York, NY, USA, 2022, pp. 25-30, **https://doi:10.1109/EITT57407.2022.00010**.

[39] Samanta, H., Talapatra, P.K., Golui, K. (2022). A Proposed Model for the Academia-Industry Collaboration: A Case Study. In: Auer, M.E., Hortsch, H., Michler, O., Köhler, T. (eds) Mobility for Smart Cities and Regional Development - Challenges for Higher Education. ICL 2021. Lecture Notes in Networks and Systems, vol 389. Springer, Cham. **https://doi.org/10.1007/978-3-030-93904-5_68**

[40] Schreiber, L. M., & Valle, B. E. (2013). Social constructivist teaching strategies in the small group classroom. Small Group Research, 44(4), 395-411. **https://doi.org/10.1177/1046496413488422**

[41] Shimazoe, J., & Aldrich, H. (2010). Group work can be gratifying: Understanding & overcoming resistance to cooperative learning. College teaching, 58(2), 52-57. **https://doi.org/10.1080/87567550903418594**

[42] Siller, H.-S., & Ahmad, S. (2024). Analyzing the impact of collaborative learning approach on grade six students' mathematics achievement and attitude towards mathematics. Eurasia Journal of Mathematics, Science and Technology Education, 20(2), em2395. **https://doi.org/10.29333/ejmste/14153**

[43] Skinner, E. A., Pitzer, J. R., & Steele, J. (2013). Coping as part of motivational resilience

[44] in school: A multi-dimensional measure of families, allocations, and profiles of academic coping. Journal of Educational and Psychological Measurement, 73(5), 803-835

[45] Slavin, R. E. (2018). Educational psychology: Theory and practice (12th ed.). Pearson.success in elementary education. MANAS Journal of Social Studies, 10(19), 251-268. https://dergipark.org.tr/en/download/article file/843622 adresinden al nd

[46] Sun, D., Looi, C. K., Yang, Y., & Jia, F. (2025). Exploring students' learning performance in computer-supported collaborative learning environment during and after pandemic: Cognition and interaction. British Journal of Educational Technology, 56(1), 128-149. **https://doi.org/10.1111/bjet.13492**

[47] Torrego-Seijo C., J., Caballero-García, P. Á., & Lorenzo-Llamas, E. M. (2021). The effects of cooperative learning on trait emotional intelligence and academic achievement of Spanish primary school students. British Journal of Educational Psychology, 91(3), 928-949. **https://doi.org/10.1111/bjep.12400**

[48] Udu, D. A. (2018). Efficacies of Cooperative Learning Instructional Approach, Learning Activity Package, and Lecture Method in Enhancing Students' Academic Retention in Chemistry. Science Education International, 29(4), 220-227.

[49] Uya, A. O. (2023). Teaching Strategies, Geoboard Resource and Secondary School Students' Achievement in Mathematics in Akwa Ibom State, Nigeria. International Journal of Contemporary Studies in Education (IJ-CSE), 2(1). **https://doi.org/10.56855/ijcse.v2i1.258**

[50] Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

[51] Wright, G. W., & Park, S. (2022). The effects of flipped classrooms on K-16 students' science and math achievement: a systematic review. Studies in Science Education, 58(1), 95-136. **https://doi.org/10.1080/03057267.2021.1933354**

[52] Zakaria, E., Solfitri, T., Daud, Y., & Abidin, Z. Z. (2013). Effect of cooperative learning on secondary school students' mathematics achievement. Creative education, 4(2), 98-100. **http://dx.doi.org/10.4236/ce.2013.42014**

[53] Zhang, Q., Lin, S., Liu, J., & Jin, Y. (2022). A game perspective on collaborative learning among students in higher education. Cogent Education, 9(1), 2115617. **https://doi.org/10.1080/2331186X.2022.2115617**

[54] Zhou, M., & Brown, D. (2015). Educational learning theories: 2nd edition. Education Open Textbooks. **https://oer.galileo.usg.edu/education-textbooks/1/**