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FOSTERING NUMERACY SKILLS AND INTEREST AMONG GRADE 7 STUDENTS THROUGH CROSS-AGE PEER TUTORING

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ABSTRACT

This study examined the impact of cross-age peer tutoring on the numeracy skills and mathematical interest of non- and low-proficient Grade 7 students. Highly proficient Grade 9 students were tutors in a structured tutoring program designed to support struggling learners through collaborative and personalized instruction. To assess the effectiveness of the intervention, the Enhanced Regional Unified Numeracy Test (ERUNT) was administered before and after the program to measure the changes in numeracy skills. Additionally, students' interest towards mathematics was evaluated using bivariate analysis to determine any significant relationships between the intervention and affective outcomes. Recognizing students' challenges in developing numeracy skills and maintaining engagement, the research focused on utilizing older, highly performing peer tutors from higher grade levels to provide structured, collaborative support to Grade 7 learners. The study employed a mixed-methods approach, combining pre- and post-assessments of numeracy performance with a survey questionnaire to gauge changes in student interest and attitude toward mathematics. 70 Grade 7 students were identified as participants, divided into a control and an experimental group. Results revealed a statistically significant improvement in numeracy performance and a positive shift in students' interest and attitude towards mathematics. These findings suggest that cross-age peer tutoring effectively enhances academic performance and student engagement in mathematics among Grade 7 low-performing students. The study recommends integrating such peer-based approaches into regular mathematics instruction to support differentiated learning and promote a collaborative educational environment.

Keywords: Cross-age peer tutoring, Numeracy skills, Mathematical interest, Numeracy performance, Student engagement, Grade 7 Students, Collaborative educational environment

INTRODUCTION

Mathematics has long been a fundamental subject in the education of students, providing a foundation for problem-solving, critical thinking, and quantitative literacy. However, not all students find mathematics equally engaging, and many face challenges in understanding and excelling in this subject. Performance in mathematics reflects not only a student's abilities but also their interest and motivation to learn.

In recent years, educational strategies have evolved to address these challenges, focusing on peer tutoring. Peer tutoring is a pedagogical approach that has gained recognition for its potential to enhance academic performance and foster interest in various subjects. This research centers on the application of cross-age peer tutoring as a means to improve numeracy skills and stimulate interest in mathematics among Grade 7 students.

Peer tutors, whether from the same grade or, as in this study, from a higher grade, can offer struggling math students individualized support that is often unavailable in large classrooms. Furthermore, when students actively participate in a learning activity, they develop a deeper understanding of the material being taught. By engaging with peer tutors, learners could be encouraged to become increasingly mindful of the task and, in return, are often more motivated to continue with the task (Kim et al.,2015).

In Mathematics, Cross-Age Peer Tutoring refers to older students assisting younger peers in understanding mathematical concepts and solving problems. This approach can enhance the learning experience for both the tutor and the tutee. Tutors can reinforce their understanding by teaching, while tutees benefit from personalized support. This method not only improves mathematical skills but also promotes communication, teamwork, and a positive attitude toward learning, contributing to a more inclusive and collaborative mathematics learning environment.

In the local setting, at Matalom National High School, it is observed that some students, including those who are in the higher grade levels, exhibit difficulty in answering mathematical tasks, specifically performing the four fundamental operations in mathematics (addition, subtraction, multiplication, and division). Moreover, they are also very slow in processing basic mathematical skills and cannot even memorize the multiplication table. Based on the quarterly Numeracy Test results, the high number of low and non-proficient among Junior high school students caused the given scenarios and circumstances to be alarming and unexpected for high school students. This encouraged the researcher to find out why there are some high school students could not even solve simple addition or subtraction problems. As a mathematics teacher, the researcher aims to seek solutions/ strategies to solve these problems.

The study aims to determine whether cross-age peer tutoring can enhance numeracy skills and student interest in mathematics among Grade 7 students. Specifically, this study investigates the potential advantages of peer tutoring across all age groups concerning numeracy skills development and fostering an interest in mathematics among different age groups.

This study benefits a wide range of stakeholders. For students, as both respondents and beneficiaries, it provides meaningful learning experiences in mathematics, helping them become more knowledgeable, resourceful, and engaged. Tutors gain personal and academic growth, along with enhanced confidence and a stronger sense of efficacy. Mathematics teachers, as implementers of the study, can deepen their understanding of cross-age peer tutoring as an innovative approach to improve learners' numeracy skills and interest in mathematics, especially in fundamental operations involving integers.

This method also promotes greater student motivation and enjoyment. Math coordinators can apply the results across schools in the district, using the study as a model for performance improvement and innovation in teaching. School administrators may use the findings as a platform to adopt and benchmark new strategies for enhancing mathematics education. Parents are provided with insights into effective learning methods, enabling them to support their children's education and collaborate more closely with teachers. Policymakers can use the results to guide the development of educational policies and funding initiatives that support cross-age peer tutoring. Researchers can contribute to the broader field of education by integrating the findings into training programs and expanding knowledge on effective interventions.

Finally, future researchers can build upon this study to explore further dimensions and applications of cross-age peer tutoring in mathematics education. What sets the study " Fostering Numeracy Skills and Interest Among Grade 7 Students Through Cross-Age Peer Tutoring " apart from other peer interventions is its emphasis on cross-age tutoring, where older students serve as tutors to younger peers. Unlike many peer tutoring programs, this study explores the impact of older, more advanced students mentoring younger learners. The study further distinguishes itself by focusing on the dual outcome of both academic performance and learner engagement- two critical but often separately studied dimensions in mathematics education.

The instructional guide produced from the study serves as a vital tool for educational practitioners. By providing step-by-step procedures, strategies, and sample activities grounded in actual classroom application, the guide ensures that the cross-age peer tutoring intervention can be effectively and consistently implemented in diverse learning environments. Ultimately, it supports the institutionalization of peer tutoring as a sustainable, scalable, and evidence-based practice to improve numeracy skills and foster interest in mathematics among Grade 7 learners.

Theoretical Framework

This research was anchored on Vygotsky's Social Constructivist Theory, which highlights how learning develops through social engagement and cooperative experiences. According to Vygotsky, L.S, in 1978, learning occurs most effectively when students engage in shared activities and dialogue within their Zone of Proximal Development (ZPD)- the range between what they can do independently and what they can achieve with guidance. In the context of this study, cross-age peer tutoring serves as a practical application of this theory, where older or more knowledgeable peers support the learning og Grade 7 students. The theory is particularly relevant as it underscores the role of social context and peer support in fostering numeracy skills and interest in mathematics, aligning with the study's aim to enhance learning outcomes through structured peer interactions.
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Cross-age peer tutoring aligns with this theory as it involves students of different ages teaching and learning from each other. In this context, the older peer serves as a model for the younger peer, demonstrating skills and behaviors from which the younger peer can observe, imitate, and learn. The interaction between peers in cross-age peer tutoring provides a social context for learning, reinforcing the principles of Social Learning Theory by emphasizing the importance of social influence and observational learning in the educational process.
Social learning theory has four principles that can help determine whether a new behavior has been learned. These principles are:

Attention. The degree to which an observer notices certain behavior. Learning can only occur if people are paying attention. Keep in mind the number of behaviors we observe every day and don't imitate. Typically, humans only learn the things that they consider to be interesting, unusual, and useful – an important factor to keep in mind when practicing social learning with students.

Retention. How well the observer remembers behaviors is crucial in determining if they will be able to mimic the actions in the future.

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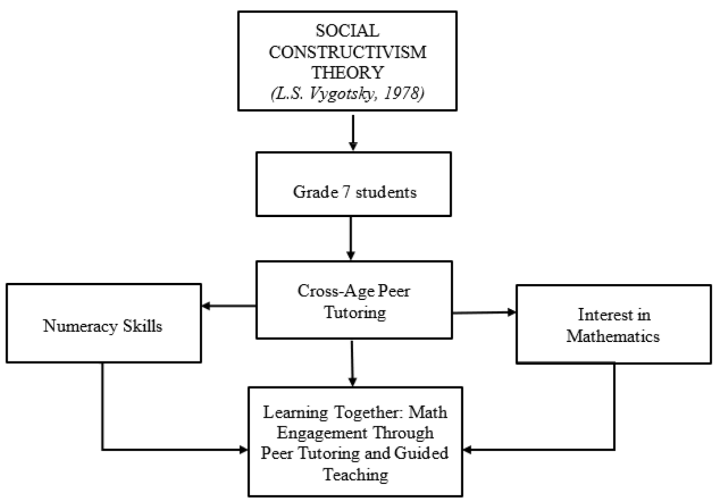
Reproduction. Social learning in action. The ability to perform learned behaviors in a different context.

Motivation. The desire to reproduce the behavior. This can depend on the repercussions or reinforcement that occurred as a result of imitating the behavior.

Vygotsky's sociocultural theory about child development says that cognitive development occurs as a result of social interactions. In this way, learning is innately collaborative. He believed social negotiation was essential for building knowledge and understanding concepts. The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky believed that everything is learned on two levels. First, through interaction with others, and then integrated into an individual's mental structure. According to Vygotsky, scaffolding is the breaking down of information or parts of a new skill into pieces that are digestible for the learner. He suggested that students should be educated where they are capable of learning with peer support, instructional strategies, and regular assessment. Vygotsky's theory has been used to inspire a focus on interactive and collaborative organizations of teaching and learning that encourage students to learn from social interactions with peers and with the teacher.

Motivation is an important predictor of learning and achievement. The hope is that the more motivated a student is, the greater dedication and attention they will pay to their studies. A well-studied theoretical explanation of motivation is the Self-Determination Theory. Understanding it can transform the way you teach and maximize your students' learning. SDT emphasizes the satisfaction of basic human needs for autonomy, competence, and relatedness as a key driver of motivated behavior (Ryan and Deci, 2000). Unlike traditional motivation theories that focus primarily on the amount of motivation (e.g., goal-setting theory), Self-Determination Theory (SDT) highlights the quality of motivation as equally important. A central insight of SDT is that motivation exists along a spectrum—from intrinsic (driven by personal interest) to extrinsic (driven by external rewards). While both types can spur action, SDT proposes that they differentially impact performance and well-being.



Cross-Age Peer Tutoring is the independent variable, while Numeracy skills and Interest in Mathematics are the dependent variables. It is assumed that Grade 7 students who received cross-age peer tutoring will have better numeracy skills and increase their level of interest in mathematics.

The theoretical framework of this study incorporates Social Learning Theory, Sociocultural Theory, and Self-determination Theory. These emphasize the role of observational learning and social reinforcement in the context of peer interactions. Bandura's theory on modeling behavior and reciprocal determinism is central to understanding how students' numeracy skills and interest in mathematics can be influenced by observing and engaging with older peers through tutoring.

Learning is a social activity - it is something we do together, in interaction with each other, rather than an abstract concept (Dewey, 1938). For example, Vygotsky (1978), believed that community plays a central role in the process of "making meaning." Vygotsky posited that a child's cognitive development is fundamentally shaped by their social and cultural environment, which determines both how they think and what they consider meaningful. From this perspective, education is inherently a collaborative process—one where knowledge is co-constructed through social interaction and collective meaning- making.

Statement of Purpose

The study aimed to determine the effectiveness of cross-age peer tutoring on the numeracy skills and level of interest in mathematics among Grade 7 students in Matalom National High School for the school year 2023-2024 as a basis for instructional guides in Mathematics.

Specifically, the study sought to answer the following questions:
1. What are the pre-test and post-test scores of the grade 7 students in Mathematics exposed to:
   1.1. cross-age peer tutoring; and
   1.2. lecture method?
2. Is there a significant difference in the pre-test performance of the students in the cross-age peer tutoring and lecture method?
3. Is there a significant difference in the pre-test and post-test scores exposed to
   3.1. cross-age peer tutoring; and
   3.2. lecture method?
4. Is there a significant mean gain score between the
   4.1. cross-age peer tutoring; and
   4.2. lecture method?
5. What is the level of interest of Grade 7 students towards cross-age peer tutoring?
6. Based on the findings, what instructional guide in Mathematics can be proposed?

Statement of Hypotheses

At .05 level of significance, the hypotheses state that:
H01: There was no significant difference of pre-test and post test performance scores between students in the cross-age peer tutoring and students exposed to lecture method.
H02: There was no significant mean gain score between the cross-age peer tutoring and lecture method.

Literature Review

This chapter discusses the related literature and studies that lend support to this research. The first part presents the literature related to cross-age peer tutoring, then the students' performance in Mathematics, interest in Mathematics, and insights into the study. Such a review gave a new feature in the numeracy skills and interest in mathematics of Grade 7 students, out of the readings from books, journals, and other sources from libraries and websites.

Cross-age peer tutoring

According to Farooq, Saba et al (2021), peer tutoring is one of the teaching methodologies that allow tutees to learn from their peers who might be their class fellows or senior students, either from the same department or not. The study aimed to examine how peer tutoring influences the intrinsic motivation, social intelligence, and study skills of prospective teachers. In this setup, tutees were given the freedom to ask questions without any limitations, creating an open and supportive learning environment that encouraged active participation and engagement.

Flores and Duran (2013) state that most of the time, students like the idea of receiving help from their peers during the learning process. Peer tutors acquire or have acquired the same academic content as their peers, so they know the difficulties their peers may experience when learning it. Sharing cultural and linguistic references, using a more direct speech, and confidence between them are other factors that should also be considered, as stated by these researchers. Different definitions of peer tutoring have been used over the years. Recent research has shown that students can effectively teach each other. Some students can learn more easily when taught by their peers than when taught by their teachers. It is also easier for them to be corrected by fellow students than to be checked by their teachers because their peer tutor is not an authority figure (Lindgren, 1976). The practice of students teaching other students has a rich history dating back thousands of years, even to the ancient Greeks (Topping, 1998; Wagner, 1990). Peer-assisted learning has existed in various forms for a long time, but it was only in the past few decades that it began to receive significant recognition and attention within the scientific research community. During this time, the emphasis shifted from using peer-assisted learning as an economical way to improve the tutee's learning to see it as an approach that has potential benefits for both the tutors and the tutees (see Allen, 1976; Cohen, Kulik, & Kulik, 1982; Devin-Sheehan, Feldman, & Allen, 1976; Foot & Howe, 1998; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003).

Research on peer-tutoring programs has consistently shown that they contribute positively to students' academic performance in mathematics (e.g., Bar-Eli & Raviv, 1982; Cohen et al., 1982; Heller & Fantuzzo, 1993; Menesses & Gresham, 2009; Sharpley et al., 1983; Thurston et al., 2020). The success of peer-assisted learning is often attributed to its alignment with student-centered learning environments, which are known to enhance academic achievement as well as boost students' self-esteem and self-concept (Alegre et al., 2020; Ginsburg-Block et al., 2006). In addition, Topping et al. (2003) found that peer tutoring improved cooperation among students since the tutor and tutee have multiple opportunities to discuss and work together. Peer-tutoring programs have also been found to be a more cost-effective way to improve mathematics performance than many other alternatives, such as computer-assisted instruction (Yeh, 2010).

Comparative studies such as the work conducted by Jenkins and Fuchs (2019) emphasized the benefits of cross-age peer tutoring in contrast to same-age arrangements. The older peers' greater maturity, knowledge base, and enhanced communication skills were identified as factors that potentially magnify the effectiveness of cross-age peer tutoring. This suggests a unique advantage in utilizing older peers to mentor younger students in mathematics, offering a diverse perspective and potentially stronger role modeling. Research by Topping (2018) illustrated the positive impact of peer tutoring on mathematical skills, indicating significant improvement in test scores and problem-solving abilities among students engaged in peer-assisted learning. These findings align with the notion that peer tutoring, by providing individualized support and scaffolding, contributes to enhancing academic performance in mathematics. The last studies in the field conclude that students' interactions during peer tutoring have positive significant effects on students' mathematics learning (Alegre et al., 2019c; Gamlem, 2019). Flores and Duran (2013) stated that most of the time, students like the idea of receiving help from their peers during the learning process. Peer tutors acquire or have acquired the same academic content as their peers, so they know the difficulties their peers may experience when learning it. Sharing cultural and linguistic references, using a more direct speech, and confidence between them are other factors that should also be considered, as stated by these studies.

Traditional Lecture Method

Lessani et al. (2017) cited that the traditional teaching method is teacher-centered instruction. The traditional method is based on the behaviorist learning theory. Behaviorism refers to the learning theories emphasizing changing behavior, which results from learners' associations of stimulus-response. It asserts that learning is a change in behavior due to experience (Ormord, 1995). In a mathematics class using the traditional method, the teacher reviews previous material and homework and then demonstrates low- level problem-solving, followed by seatwork imitating the teacher's demonstration (Stonewater, 2005). This pedagogical approach of placing the primary focus on the teacher as a transmitter of knowledge (that is, teaching by telling) is representative of behaviorist theory (Hackman, 2004).

The common method of teaching mathematics using the traditional method is teacher-centered, and giving lectures is the dominant situation. D'Inverno (2003:19) notes that "Most of the lectures which students attend require little engagement and they may well have developed a passive mentality in which some largely expect to switch off". The traditional lecture method may not be the most effective teaching strategy for lectures, as its very nature creates a very dominantly passive learning experience where students are generally exposed to information, yet rarely are given the opportunity to process it. Perhaps no other teaching method is more widely used and criticized than the lecture method. The pure (traditional) lecture method is typically discouraged by educators who adhere to learner-centered, creative, or innovative education.

A lecture is a discourse read or delivered before an audience or class, especially for instruction. The picture of an all-knowing teacher looking at the students as mere receptacles of knowledge typifies traditional lectures. In this method, the teacher serves as an expert, guiding students through the material and providing the immediate clarification on any misunderstandings. Many students are accustomed to this method of instruction, making it easier for them to engage with the material. On the contrary, this method provides minimal opportunities for students to ask questions or engage in discussion may hinder deeper understanding. The traditional lecture method emphasizes rote memorization and procedural understanding and real-world application, potentially limiting long-term comprehension.

Interest in Mathematics

Interest plays a dominant role in making a student learn something. There may be various factors affecting the interest of students in the subject of mathematics. Another factor that can result in low achievement in mathematics may be attributed to students ' interest in learning mathematics (Luzano, 2023). The studies have also shown that students' attitude toward problem-solving in terms of patience, confidence, and willingness has a positive relationship with students' mathematics achievement (Mohd et al., 2011). The current trends in education confirm that instructors are shifting away from authoritarian and non-interactive methods to a learner-centered approach that includes peer tutoring (Galy et al., 2011).

According to Zan & Di Martino (2007), a student's interest in Mathematics is defined as a more complex scenario characterized by the emotions that one associates with Mathematics, one's beliefs about Mathematics, and how one behaves toward Mathematics. A lack of enthusiasm or motivation for learning mathematics often leads to poor academic performance in the subject. Interest is one of the attitudinal and influential variables that are predictors of students' achievement in learning or avoidance of learning mathematics (Singh et al., 2002). Studies have shown the trend of poor performance in mathematics in many parts of the world (Mazana et al.,2020; Mbugua et al., 2012; Ndume et al., 2020; Sa'ad et al., 2014).

The consistent pattern of low performance in mathematics is linked to students' lack of interest in the subject, as many perceive it to be dull and unengaging. Factors such as teachers' lack of innovative pedagogies, the subject's broad content, and students' inadequate practices amplify students' low interest in learning (Shoaib and Saeed, 2016). Innovative teaching methods are crucial in tackling the issues of students' lack of interest and low performance in the subject. Interest is one of the internal factors that influence learning and student learning outcomes.

Interest is very crucial. Someone with a high interest in mathematics will certainly have a high motivation toward mathematics. The higher learning interest will also lead to a positive attitude of students towards mathematics. Student engagement in mathematics is multifaceted and has affective, cognitive, and behavioral constructs, and the level of engagement affects the quality of the learning outcome(AlMutawah & Fateel, 2018; Fredricks et al., 2004; Kong et al., 2003). When students believe that they will experience success in mathematics, they are more likely to engage in and enjoy the subject (Middleton & Spanias, 1999; Putwain et al., 2018). Cultivating student engagement is as important as the design of the curriculum itself (Kong et al., 2003).
Students' Academic Performance in Mathematics

The student's performance will play an important role in producing the best quality graduates who will become great leaders and manpower for the country, thus responsible for the country's economic and social development (Ali et.al, 2009). According to Waters & Marzano (2006), there is a range of factors that affect the quality of performance of students. Obama (2004) asserts that parents have the primary responsibility of instilling an ethic of hard work and educational achievements in their children.

According to the article by Capuno et al. (2019), Mathematics is not only a subject but also relates to many things in human daily life. Its study provides students with basic life skills and processes that will prepare them to be productive members of society. Thus, proper and coordinated utilization of innovation impacts each aspect of mathematics education: what mathematics is taught, how mathematics is taught and learned, and how mathematics is assessed.

The research study of Guinocor et, al., (2020) mentioned that in Asia, mathematics is viewed as one of the most critical subjects wherein students are encouraged to study the discipline (Leatham & Peterson, 2010; Ronis, 2008) that it is in this view that in most Asian countries, guiding practices on children's mathematics achievements are quite more vigorous (Wei & Dzeng, 2014). As indicated by Etcuban and Pantinople (2018), that showing acquired an attractive change in the conduct of learning. According to recent research, the attitude of the learners towards mathematics may also affect the performance of the subject.

Educational services are often not tangible and are difficult to measure because they result in the transformation of knowledge, life skills, and behavior modification of learners (Tsinidou, Georgianni, &Fitsilis, 2010). According to Zumbrum, Tadlock, & Roberts (2011), students' ability to manage their "thoughts, behaviors, and emotions to successfully navigate their learning experiences" is known as self-regulated learning.
Guinocor et al. (2020), as cited by Biswas (2015), state that "Students' performance in mathematics, as indicated by the grades they achieved, is affected by various factors. Among the different influencing factors, this study will primarily focus on students' affective traits, specifically their study habits and attitudes toward learning, collectively referred to as study orientations.

Mathematics is one of the most significant and colorful subjects in any discipline. Jose (2015) cited that Mathematics is an aid to represent and attempt to resolve problem situations in all disciplines. It is an interdisciplinary tool and language. Mathematics is not only a language and a subject in itself, but it also plays a big role in fostering logical and critical thinking in students. Educational researchers have expended time and energy trying to unravel the possible causes of students' poor attitudes and performance in mathematics. Research findings indicate that teachers facilitate learning by truly caring about their students' engagement and creating the right atmosphere that enhances student learning (Noddings, 1995).

The learner draws from his teachers' disposition to form his attitude, which may likely affect his learning outcomes (Yara 2009). Teachers with a positive attitude towards Mathematics were inclined to stimulate favorable attitudes in their pupils. For Zan and Martino (2007), attitude towards Mathematics is just a positive or negative emotional disposition towards mathematics. Sauer (2012) found that students' interest in learning is one of the contributing factors to successful academic performance.

The effectiveness of teaching and learning is greatly influenced by the quality of the teacher, which is enhanced through proper training and experience. In particular, teaching experience is a key factor contributing to educational

success. Baruah (2010) revealed that mathematics performance in school is positively correlated with (a) the academic performance of the school, indicated by school leaving pass percentage, and also
(b) with the performance in subjects other than mathematics.

According to other research studies on learning mathematics, there some many reasons and factors that affect the performance of the students, and one of the factors is the strategy being used by the teacher, which affects children in learning effectively in the context of mathematics. Despite the innovative teaching strategies evolved today, the performance of the students in Mathematics remains low and alarming. This is shown in the result of the Third International Mathematics and Science Study (TIMSS), where the Philippines ranked 39th out of 41 participating international countries, according to Mullis as cited by Cordova and Tan (2018). It implies that the educational system in our country has a problem in different aspects, especially in mathematics education.

According to Nzesei (2015), one of the most significant challenges in learning is for individuals to take responsibility for their learning. When students take ownership of their learning, they are more likely to find meaning in the learning process, which in turn fosters more effective learning. To support this, it is important to carefully design and manage learning environments that encourage meaningful interaction, as this can help individuals maximize their learning potential (Singh, 2017).

Retention and simple recall are some basic concerns that we need to address for the improvement of the system. Still, in recent results in the National Achievement Test, most schools and institutions did not make it to the passing rate set by the National Educational Testing and Research Center (NETRC). Moreover, a study by Liu and Koirala (2009) found that efforts are needed to promote mathematics self-efficacy for high school students because it was positively associated with mathematics achievement.

Mathematics requires learning by doing, where the learners are involved in their understanding of mathematical concepts. Stephenson (undated) quoted that, "Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge.

Cross-age peer tutoring combines the strengths of both formal and informal learning environments and aims to provide students with the best of both worlds. Through this study, the learners will be able to develop in solving both routine and non-routine math problems and applying them in real–life situations. This strategy will link from formal to informal settings. Cross-age peer tutoring strategy is one of the modern and innovative learning strategies that encourages learners to study sincerely and study to satisfy the learner's curiosity.

Gilliam (2019) stated that Cross-age peer tutoring enhances students' understanding and retention of course content. According to Henry Mintzberg (2005), in his observation about training leaders, deep learning requires experience, which will require taking action. It will be as much as doing to think as thinking to do. This strategy will be a venue for the improvement of the academic performance of learners in mathematics.

Mathematics plays a major role in higher education as it is particularly essential to develop the analytical thinking of students. Investigating student academic performance has been a crucial aspect of educational research recently. Through Cross-age peer tutoring, learners develop a conceptual and deeper understanding of mathematics skills, leading to improved performance in Mathematics. Guinocor et al. (2020), as cited by Biswas (2015) that "Students' performance in mathematics, as indicated by the grades they achieved, is affected by various factors. This study will mainly concentrate on students' affective characteristics, particularly their study habits and attitudes toward learning, which are collectively termed as study orientations.

The existing literature on the effects of peer and cross-age tutoring is broad and varied, covering multiple subject areas, programs of differing lengths, and examining the influence of various tutor and tutee characteristics. It also explores the overall effectiveness of tutoring initiatives and their diverse outcomes.

The relationship between mathematics performance and interest in mathematics is a crucial aspect that influences learning outcomes. Deci and Ryan's Self-Determination Theory (2000) posits that intrinsic motivation significantly impacts student engagement and interest in a subject. Peer tutoring, with its potential to foster supportive and motivating learning environments, may positively influence students' interest in mathematics by promoting a sense of competence and autonomy.

As far as the origin of peer tutoring is concerned, it has strong roots both in behaviorist and constructivist approaches to learning. According to the behaviorist approach to learning, the outcome of peer tutoring can be improved by rewarding the tutors for their good performance or providing other favorable conditions for tutoring. Here, the outcomes of peer tutoring are conditioned to some external stimuli, which is the main idea of Skinner's Learning Theory.

In the same way, the constructivists- both Vygotsky and Piaget were in favor of peer tutoring. According to Piaget, learning does not occur totally from external influence; rather, it is a reconstruction process in the human mind. Piaget's cognitive theory admits that the cognition of both tutors and tutees develops in all stages of peer tutoring. According to Dr. Emily Parker, the author of the article "The Power of Cross-Age Tutoring: A Mutually Beneficial Learning Experience", the concept of cross-age tutoring has emerged as a powerful tool for fostering a collaborative learning environment. This innovative approach, where older students mentor and assist younger ones, not only bolsters academic achievement but also nurtures personal development and social skills in both age groups. Dr. James Thompson, in his article "Breaking Barriers Through Cross- Age Tutoring", delved into the transformative impact of cross-age tutoring on breaking traditional educational barriers, emphasizing the importance of collaborative learning environments and their influence on personal and academic growth across different age groups. In addition, the article "Academic Gains and Social Development" by Dr. Sarah Reynolds, a leading figure in the field of psychology and pedagogy, has shown that cross- age tutoring contributes significantly to academic success.

The personalized assistance provided by older students can lead to improved comprehension, enhanced problem-solving abilities, and increased confidence among younger learners. Furthermore, beyond academic achievements, this collaborative learning approach cultivates a sense of responsibility and empathy in older students. They learn to adapt their communication styles to effectively teach and support their younger peers. This experience fosters patience, empathy, and the ability to adapt to diverse learning needs, essential skills that are valuable in both academic and real-world scenarios.

According to the news posted in 2020, in the TIMSS results, Filipinos fared worst among 58 countries in an assessment for mathematics and science for Grade 4 students, according to a study by a Netherlands-based research institution (Baclig, 2020). According to the 2019 Trends in International Mathematics and Science Study (TIMSS) conducted by the International Association for the Evaluation of Educational Achievement (IEA), the Philippines scored 297 in mathematics and 249 in science. These results reflect a significant decline compared to the country's 2003 scores, which were 358 in mathematics and 332 in science.

Summary

Education continually seeks innovative methods to enhance students' numeracy skills and foster interest in challenging subjects such as mathematics. The integration of cross-age peer tutoring has emerged as a promising approach to achieving these goals, particularly in the domain of mathematics among students. This literature review explores prior research, examining the impact of cross-age peer tutoring on academic performance and the development of interest in mathematics. By investigating existing studies and theoretical frameworks, this review aims to clarify the effectiveness and implications of cross-age peer tutoring in fostering a deeper comprehension of mathematical concepts and a heightened enthusiasm for the subject within this specific grade level.

RESEARCH METHODOLOGY

In conducting the research, a methodological framework has been designed to comprehensively investigate the impact of cross-age peer tutoring on numeracy skills and interest in mathematics among this specific student cohort. This chapter describes the research design, participant selection criteria, data collection methodologies, and the analytical approaches adopted to rigorously examine the efficacy of cross-age peer tutoring. This methodology endeavors to provide a refined understanding of the influence of cross-age peer tutoring on the mathematical capabilities and interest levels of Grade 7 students.

Design

This study employed the parallel quasi-experimental design. The concept of quasi- experimental designs has evolved; Donald T. Campbell and Julian C. Stanley are widely credited with formally introducing this design in 1963. Parallel quasi-experimental design is a type of research design where two or more groups are studied simultaneously (in parallel), with one serving as the experimental group and the other as the control group. However, unlike a true experimental design where participants are randomly assigned to groups, in a quasi-experimental design, the assignment to the group is not random. Instead, groups are often pre-existing or naturally occurring, and the researcher does not have control over the assignment process. Despite not having true randomization, quasi-experimental design still aims to assess the cause-and-effect relationship between variables.

Environment

The study was conducted at Matalom National High School. The institution is situated in a hilly portion of Quezon Drive, Brgy. San Isidro, Matalom, Leyte. This high school was established in 1985. There are 58 teaching and 5 non-teaching personnel in the school supervised by a school principal with 844 junior high school students and 477 senior high school students.

It is a public institution where students learn in a child-friendly, gender-sensitive, safe, and motivating environment that allows learners to be successful individuals someday. The school offers junior and senior high schools with teachers who facilitate learning and constantly nurture every learner. It is considered the biggest high school in the whole north and south districts, as it has the largest population compared to other high schools. It received different awards for the performance of the learners and the school itself. At present, its existence has greatly catered to the educational needs not only in the Poblacion but also in its neighboring barangays in the North and South Districts of the Municipality of Matalom. The majority of the students reside in far-flung barangays and regularly hike 3 to 5 kilometers to school every day.

Respondents

There were one hundred eighty-one (181) Grade 7 learners at Matalom National High School. 70 students were identified as low and non-proficient based on the result interpretation of the quarterly numeracy test. The identified learners were divided into two groups: the control group and the experimental group, with 35 students in each group, respectively. Tossing of a coin will be used in assigning these two groups. One group was the experimental group, which was exposed to the cross-age peer tutoring strategy, and the other group was the control group, which was treated with the conventional lecture method. In the study, grade 7 students who were non-proficient or had low proficiency in numeracy were selected as respondents to address their foundational gaps. The goal was to enhance their basic numeracy skills and interest, ensuring they are better prepared as they move to higher grade levels. Parents willingly granted consent for their children to take part in the study, ensuring that the participants were in good physical, mental, and emotional health during the data collection process.Based on the first-quarter ERUNT result, the low- and non-proficient Grade 7 students of Matalom National High School were selected as the respondents for the study. The identified tutors were the highly proficient Grade 9 students of the school in a one-to-one ratio.

Instruments

To determine the numeracy skills of the respondents on basic operations in mathematics, the research instrument used in this study was the "Enhanced Regional Unified Numeracy Test (ERUNT) for Key Stages 2, 3, and 4" (Refer to Regional Memorandum No. 1092, s. 2023 – Guidelines on the Utilization of the Enhanced Regional Unified Numeracy Test).

The Enhanced Regional Unified Numeracy Test was intended for all Grades 1 to 11 learners in all public and private schools in DepEd Region VIII. ERUNT was a 20-item test with three parts: Operation of Integers (Items 1–8), Missing Integers (Items 9–16), and Problem-Solving (Items 17–20). It measured the learners' competencies in the four fundamental operations in Mathematics (Addition, Subtraction, Multiplication, and Division) involving integers, understanding numbers, and problem-solving.

In this study, to determine the level of engagement in mathematics, the instrument used was a survey questionnaire based on Bivariate Analysis and a Chi-square Test of Association, which were commonly used in social research to test the relationship between two variables. The instrument consisted of 33 items. A Likert-type scoring format was used for each of the subscales: behavioral (11 items), emotional (10 items), and cognitive engagement (12 items). Students were asked to indicate the extent of their agreement with each statement on a four-point scale from highly engaged (strongly agree) to highly not engaged (strongly disagree), scored from 4 to 1.

Validity and Reliability of the Instrument Used

Validity refers to the extent to which the instrument measures what it is supposed to measure according to the researcher's subjective assessment (Nachmias & Nachmias, 2007). The instrument used in this study was validated by the Curriculum and Learning Management Division (CLMD) of Region VIII.

Data Gathering Procedures

Pre-Data Collection. The initial step undertaken by the researcher was seeking approval from the Dean of the College of Education of the University of the Visayas, based on the recommendation of the panel of examinees, for the data-gathering procedures related to this research study. The researcher complied with the requirements for ethical clearance through the Institutional Review Board (IRB) Office. Once the IRB granted approval, a Notice to Proceed (NTP) was secured prior to the start of data collection. Upon receiving the notice, the researcher requested approval from the Department of Education Division Office and obtained permission from the School Principal of Matalom National High School. This step was necessary because the researcher was employed at the said public school where the study was conducted.

Actual Data Collection. Once approved, a pretest was given to the selected Grade 7 high school learners. The learners were divided fairly; one group served as the control group and the other group as the experimental group. Before the experimentation, a pretest was administered to both groups. The control group was exposed to the traditional mode of learning. The experimental group was also given the traditional method of teaching and was exposed to cross-age peer tutoring, focusing on basic mathematical operations involving integers, with the Grade 9 students serving as tutors.

In the first week, the researcher visited the sampled students to introduce the study and explain its purpose, as well as to obtain permission to use the classrooms and involve the selected students in the study. The pretest was then administered to all participating students, both in the control and experimental groups.

In the second week, the students were divided into two groups: the experimental group and the control group. The experimental group received cross-age peer tutoring in addition to the traditional method, while the control group received only the traditional method of teaching. The teacher in charge of Mathematics 7 handled both groups for the traditional instruction, while identified Grade 9 students conducted peer tutoring sessions from 4:00–5:00 PM, Monday to Friday, throughout the week. By the end of the second week, five (5) one-hour sessions had been conducted for the experimental group.

On the first day of the third week, a posttest was administered to all students involved in the study. Another posttest was given on the last day of the same week to determine the retention level of the students. (See Appendix F and G for the experimental process.)

Post Data Collection. The researcher gathered the posttest scores during the students' scheduled class after administering the posttest. The scores were placed in the drawer of the researcher's table and sealed in a brown envelope. The Mean Percentage Score (MPS) was calculated for both the pretest and posttest. These scores were then compared by the researcher. Upon receiving the results, the researcher promptly organized and consolidated the MPS. The information was tabulated, evaluated, and interpreted accordingly.

Protecting respondents' privacy was a fundamental ethical principle upheld throughout the study. This included ensuring confidentiality and the proper disposal of collected data after the conclusion of the research (Babbie, 2016). In accordance with ethical research standards and the Privacy Act, all collected data were handled with strict confidentiality. Identifiable information was securely stored, accessible only to authorized personnel, and anonymized during analysis. Upon completion of the study, physical documents were securely shredded, and electronic data were permanently deleted to prevent any unauthorized access. As noted by Israel and Hay (2006), the proper management and disposal of research data were critical for protecting participants' privacy and maintaining the integrity of the research process.

Data Analysis

The data gathered and tabulated in this research were analyzed using inferential statistics, particularly the t-test for independent samples, mean and standard deviation, frequency, and percentage, to determine the findings of the study.

The following statistical treatments were used to provide the most accurate results from the Mean Percentage Scores (MPS) of the pretest and posttest. Frequency, percentage, mean, and standard deviation were utilized in analyzing and interpreting the data on the numeracy skills of Grade 7 learners for the School Year 2023–2024.

A t-test for independent samples with unequal variance was conducted to determine whether there was a significant difference between the control group and the experimental group. It was also used to evaluate the effectiveness of the cross-age peer tutoring strategy in teaching Mathematics to Grade 7 students.

Ethical Considerations

The study adhered to the ethical consideration requirements of the University of the Visayas. Informed consent was obtained from all participants prior to data collection. Participants were assured of the confidentiality and anonymity of their responses, and they were informed of their right to withdraw from the study at any time without any consequences. The research protocol was reviewed and approved by the Research and Ethics Committee of the University of the Visayas, with Reference No. NP2024MAED- 421 dated January 21, 2025, ensuring compliance with ethical guidelines for research involving human subjects.

The research involved Grade 7 non- and low-proficient students who voluntarily participated in the survey. Before completing the questionnaires, a cover letter was provided, explaining the purpose of the study, its objectives, the voluntary nature of participation, and the assurance of confidentiality.

No financial incentives or compensation were provided to the participants. However, small tokens such as school supplies were distributed to the participants as a gesture of appreciation. The researcher declared no conflict of interest.

Furthermore, by adhering to these ethical principles, the study aimed to contribute to the development of numeracy skills and increased interest in mathematics among Grade 7 students through cross-age peer tutoring.

RESULTS AND DISCUSSION

This chapter presents the data collected during the conduct of the study, along with its corresponding analysis and interpretation. The results are organized based on the research questions and objectives, highlighting key findings through statistical treatment and relevant interpretation. Tables, figures, and narrative explanations are used to provide clarity and support for the patterns and relationships identified in the data.

Student scores in the pre-test and post-test between the teaching methods

The students' academic performance level before and after applying two different teaching strategies was assessed to determine their effect on learners' mastery of the lesson. As shown in Table 1, students exposed to cross-age peer tutoring had a pre-test mean score of 5.06, while those under the lecture method had a slightly higher pre-test mean score of 5.60. Both scores fall under the interpretation "unsatisfactory," suggesting that before the intervention, students generally struggled with mastering the lesson content.

After the implementation of the teaching strategies, students taught through cross- age peer tutoring achieved a post-test mean score of 13.17, while those under the lecture method obtained a mean score of 8.80. Despite improvements in scores for both groups, the interpretations remained within the "unsatisfactory" level. However, the more substantial gain among the peer-tutored students highlights the potential advantage of interactive, student-centered approaches in promoting greater academic improvement.

These findings are supported by previous studies, which assert that peer tutoring fosters deeper understanding and engagement among learners. Bugaj et al. (2019) emphasized that peer-assisted learning strategies enhance not only academic outcomes but also students' motivation by creating a collaborative environment. In the context of Vygotsky’s (1978) sociocultural theory, the observed improvements can be attributed to the support provided by more knowledgeable peers, enabling learners to perform tasks they would not have achieved independently. Studies by Lin et al. (2023) and Tenenbaum et al. (2020) further reinforce the idea that peer interactions stimulate cognitive development and active participation, key factors in improved academic performance.

On the other hand, while students in the lecture-based group showed a slight increase in their scores, the relatively lower improvement compared to their peer-tutored counterparts reflects the inherent limitations of traditional instructional methods. Gamo (2022) pointed out that passive teaching methods such as lectures often result in reduced student engagement and minimal knowledge retention. Alam (2023) similarly noted that active learning environments foster more significant academic gains compared to conventional, teacher-centered approaches. In lecture-driven settings, limited student interaction and participation can hinder learners’ capacity to fully internalize lesson concepts, leading to modest improvements despite instructional efforts.

Table 1.

Pre-test and post-test scores between teaching methods

Test	Method	Mean Score	SD	MPS	Interpretation
Pre-test	Cross-age peer tutoring	5.06	2.36	25.19	Unsatisfactory
	Lecture method	5.60	2.43	28.00	Unsatisfactory
Post test	Cross-age peer tutoring	13.17	3.15	65.86	Unsatisfactory
	Lecture method	8.8	4.04	44.00	Unsatisfactory

Note. n=35.
Legend. 90-100=Outstanding, 85-89=Very satisfactory, 80-84=Satisfactory, 75-79=Fairly satisfactory, 74 below=unsatisfactory.

Comparison between the pre-test of the cross-age peer tutoring and the lecture method

The comparison between the pretest scores of students subjected to cross-age peer tutoring and those taught through the lecture method was conducted to determine if there was any significant difference in their initial academic performance before the implementation of the strategies. As presented in Table 1, the mean pretest score of the cross-age peer tutoring group was 5.06, while the lecture method group had a slightly higher mean score of 5.60.

However, the difference between the two groups was found to be not statistically significant, indicating that both groups started at relatively the same level of academic performance before the intervention.
Pre-test scores are essential in educational research to establish a baseline measure of students' prior knowledge and skills before the implementation of an intervention or instructional method. In this study, the pre-test served as a diagnostic tool to determine the existing mathematical abilities of Grade 7 students before their exposure to either cross- age peer tutoring or the traditional lecture method.

Furthermore, the use of pre-tests allows for a fair comparison between groups, especially in quasi-experimental designs where random assignment may not be possible. It helps determine the equivalence of the two groups at the start of the study, thereby enhancing the internal validity of the findings (Cohen et al., 2017). Without pre-test data, it would be difficult to ascertain whether one instructional method was truly more effective than the other, or whether any observed differences in post-test performance were simply due to initial group disparities. Pre-tests, therefore, play a critical role in evaluating the net effect of an intervention.

Table 2.

Comparison between the pretest of the cross-age peer tutoring and the lecture method

Test	Group	Mean	SD	t	*P*	Decision	Interpretation
Pretest	Cross-age peer tutoring	5.06	2.36	-1.17	0.25	Failed to reject Ho	Not significant
	Lecture method	5.60	2.43				

Note: Significant if *p* value is <.05.

In Table 2, the results of the pretest indicated no statistically significant difference between the two groups ($p<0.05$), suggesting that they were comparable before the intervention. This implies that both groups were likely drawn from the same population and possessed similar baseline characteristics. Such a finding is important, as it establishes a level of equivalence between the groups, ensuring that any observed differences in the posttest can be more confidently attributed to the intervention rather than pre-existing disparities. The absence of significant differences also enhances the internal validity of the study, supporting the reliability of subsequent comparisons.

Mean Gain Score Differences Between Teaching Methods

The comparison of pretest and posttest scores for both teaching methods—cross- age peer tutoring and lecture method—was conducted to assess the impact of these interventions on student performance. As shown in Table 3, students who participated in cross-age peer tutoring demonstrated a significant improvement in their scores, with the pretest mean increasing from 5.06 to a posttest mean of 13.17. The t-test results for this comparison were statistically significant, indicating a meaningful improvement in student performance following the implementation of the cross-age peer tutoring method. These findings support prior research that highlights the effectiveness of peer tutoring in enhancing academic performance. For example, Balasubramanian (2023) emphasized that peer tutoring creates a collaborative learning environment where students actively engage with the material, reinforcing their understanding and improving retention.

Table 3.

Pre-Test- Post-Test Comparison on mean gain scores between cross-age peer tutoring and lecture method

	Test	Mean	SD	t-value	p	Decision	Interpretation
Cross-age peer tutoring	Pretest	5.06	2.36	-13.14	<.011	Reject Ho	Significant
	Posttest	13.17	3.15				
Lecture method	Pretest	5.60	4.43	-4.84	<.001		
	Posttest	8.80	4.04				

Note: Significant if *p* value is <.05.

In contrast, students who experienced only the lecture method had a pretest mean of 5.60 and a posttest mean of 8.80, with a statistically significant difference between the two scores. Although the lecture method led to improvements in student performance, the magnitude of the change was smaller compared to the improvement observed in the cross- age peer tutoring group. This result is consistent with studies showing that traditional lecture-based teaching often results in more modest gains in student performance, particularly when compared to more interactive methods (Nawabi et al., 2021). For example, Lund Dean and Wright (2017), suggested that lectures tend to encourage passive learning, which may not foster as much long-term retention or engagement as active, collaborative approaches like peer tutoring.

These findings underscore the effectiveness of cross-age peer tutoring as an instructional method, particularly in promoting active participation and deeper learning. As highlighted by Hakim (2020), peer tutoring encourages collaborative learning, where peers engage in meaningful discussions that promote critical thinking and problem-solving skills. Furthermore, the relatively smaller improvement observed in the lecture method group supports the growing body of literature advocating for more interactive and student- centered learning approaches (Tang, 2023).

Student numeracy skills in pre-test and post-test between teaching methods

The results of the dependent t-test for the mean gain differences between the control and experimental groups are shown in Table 4. Students in the cross-age peer tutoring group demonstrated a significant improvement in their scores, with a pre-test mean of 5.05 and a post-test mean of 13.17, yielding a mean gain of 8.11. The t-test result for this comparison showed a statistical difference. The large mean gain suggests that this instructional strategy had a substantial positive effect on student performance. These findings align with prior studies that support the effectiveness of peer tutoring. For instance, Bakare and Orji (2019) found that peer tutoring creates a supportive and interactive learning environment that promotes deeper engagement and better retention of material, leading to significant academic improvement.

Table 4.

Mean-Gain Difference Between Cross- Age Peer Tutoring and Lecture Method

Method	Mean Gain	SD	t-value	*p*	Decision	Status
Cross-age peer tutoring	8.11	3.65	5.42	<.001	Reject Ho	Significant
Lecture method	3.2	3.92				

Note: Significant if *p* value is <.05.

In comparison, students taught using the lecture method only also showed improvement, resulting in a mean gain of 3.2, while students taught with cross-age peer tutoring showed a statistically significant improvement, resulting in a mean gain of 8.11. The t-test for this group indicated a statistically significant improvement in scores. However, the magnitude of the improvement was smaller compared to the cross-age peer tutoring group. This suggests that while the lecture method contributed to better student performance, it was less effective than the interactive peer tutoring approach in fostering significant academic gains. This is consistent with research by Russell et al. (2016), who found that traditional lecture-based methods often produce smaller gains in student

engagement and performance compared to more interactive and collaborative methods. The findings further highlight the benefits of more student-centered teaching strategies, as discussed by Bombardelli (2016), who emphasized that active learning approaches, such as peer tutoring, tend to produce more significant educational outcomes. These results are further supported by research indicating that active learning strategies, like peer tutoring, often yield greater academic benefits than traditional lecture-based methods. For instance, Passion and Marcelo (2024) found that peer tutoring not only enhances academic performance but also promotes critical thinking, problem-solving skills, and self-confidence in students. This is particularly true in cross-age peer tutoring, where more advanced students provide guidance and support to their peers, reinforcing their understanding while helping others. Additionally, studies by Abdullah and Osman (2020) have demonstrated that peer tutoring fosters greater student engagement, which is crucial for improving long-term retention and understanding. In contrast, while lecture methods can facilitate the delivery of content to a large audience, they often lack the interactive components necessary to sustain high levels of student motivation and participation, leading to more modest gains in performance (Kumar et al., 2023).

Students' level of engagement in mathematics towards peer tutoring

The study assessed the level of student engagement in mathematics through peer tutoring across behavioral, emotional, and cognitive domains, as shown in Table 5. The findings yielded an overall mean of 2.70, interpreted as "Agree." This indicates that, in general, students exposed to cross-age peer tutoring demonstrated positive engagement in their mathematics classes.

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Table 5.

Level of students' engagement in mathematics towards peer tutoring

Statements	WM	SD	Interpretation
Behavioral			
1. I listen to my teacher in my math class.	3.09	2.82	Agree
2. I participate in the discussion in math class	2.71	2.81	Agree
3. I get easily distracted in math class	2.94	2.90	Agree
4. I work hard in math class	2.77	2.73	Agree
5. At home, I review math problems that I did not understand in school	2.69	2.67	Agree
6. When I see difficult math problems, I stop working on them.	2.40	2.95	Slightly Agree
7. Sometimes I skip difficult math questions	2.51	2.95	Agree
8. When I make mistakes in math, I work until I correct them.	2.69	2.64	Agree
9. I follow my teacher's directions in math class.	2.89	2.64	Agree
10. I sometimes act out as if I am studying in math class.	2.57	3.00	Agree
11. I ask my friends or teachers for help when I can't solve math problems.	3.17	2.56	Agree
Emotional			
1. I am interested in learning new things in math.	3.00	2.74	Agree
2. I do not like attending math classes.	2.03	2.63	Agree
3. Learning math is fun.	3.09	2.72	Agree
4. I feel excited when I study in math class.	3.00	2.87	Agree
5. I feel bored when I study math.	2.17	2.86	Slightly Agree
6. I am excited about solving difficult math problems.	2.43	2.77	Slightly Agree
7. I like to study other subjects rather than math.	2.83	2.69	Agree
8. Time passes very quickly when I study math.	2.51	3.05	Agree
9. I forget where I am when I study math	2.46	2.80	Slightly Agree
10. I want to spend more time solving math problems.	2.83	2.79	Agree
Cognitive			
1. I want to get good grades in math class.	3.29	2.42	Agree
2. Sometimes I follow my best guess when I do not know the answer.	3.06	2.91	Agree
3. When I study math, I ask myself questions to make sure I understand it correctly	2.80	2.78	Agree
4. I try to connect math to real-life situations.	2.60	2.91	Agree
5. I try to think of different ways to solve math problems.	2.54	2.98	Agree
6. I try to develop my strategy when I solve math problems	2.89	2.86	Agree
7. I set a goal for myself when I study math.	2.54	2.65	Agree
8. When I can't solve a math problem, I try to change my strategy.	2.51	2.83	Agree
9. I often think about something else when I study math.	2.46	2.90	Slightly Agree
10. At home, I think about what I learned in math class	2.49	2.82	Slightly Agree
11. I am focused when I study math.	2.43	2.65	Slightly Agree
12. I memorize important facts to understand math better.	2.86	2.85	Agree
Overall Mean	**2.70**	**2.79**	**Agree**

Note. n=35.
Legend. 1.00-1.49=Disagree; 1.50-2.49=Slightly Agree; 2.50-3.49=Agree; 3.50 4.00=Highly agree

In terms of behavioral engagement, students showed signs of attentiveness and participation, with high scores such as "I ask my friends or teachers for help when I can't solve math problems" and "I listen to my teacher in my math class". These suggest that the students were actively involved in classroom activities and followed instructions. However, some behavioral indicators revealed disengagement when facing challenging problems, such as "When I see difficult math problems, I stop working on them", which was interpreted as "slightly agree."

Emotionally, students expressed interest and enjoyment in Mathematics, as seen in statements like "Learning math is fun" and "I feel excited when I study in math class", which suggests a positive attitude fostered by peer tutoring. Nevertheless, there were signs of emotional disengagement in more effortful situations, such as "I feel bored when I study math" and "I am excited about solving difficult math problems", indicating some students struggle to maintain enthusiasm when tasks become more complex.

Cognitive engagement was evident in the desire for academic success, with "I want to get good grades in math class" receiving the highest mean. Students also demonstrated the use of learning strategies like self-questioning and guessing when unsure, as shown in "Sometimes I follow my best guess when I do not know the answer". However, low scores in statements such as "I am focused when I study math" and "At home, I think about what I learned in math class" point to the need for improving sustained concentration and reflection beyond classroom settings.

Peer tutoring, particularly the cross-age approach, has been recognized as an effective pedagogical strategy in fostering student engagement in mathematics. Its value lies not only in improving academic performance but also in enhancing students' intrinsic motivation and sense of responsibility. When students are allowed to teach or be taught by peers, they often exhibit greater accountability and develop more positive attitudes toward the subject. According to Odendahl (2016), peer tutoring allows students to construct knowledge in a more personalized and relatable context, thereby promoting engagement that is rooted in collaboration rather than competition. This dynamic contributes to a supportive learning environment where students feel more comfortable expressing confusion and actively participating in the learning process.

Moreover, engagement in mathematics is multifaceted, encompassing behavioral, emotional, and cognitive dimensions. Peer tutoring strengthens these dimensions by offering consistent feedback, social support, and opportunities for meaningful interaction. Emotional engagement is particularly influenced by the sense of belonging and self- efficacy that tutoring relationships can nurture. Feraco et al. (2023) emphasized that students who are emotionally connected to the learning experience are more likely to show persistence and curiosity, especially in subjects they may initially find difficult. In peer tutoring contexts, this emotional investment is reinforced as students feel less isolated in their struggles and more encouraged by shared experiences.
Cognitively, students involved in peer tutoring are more inclined to develop metacognitive skills such as self-monitoring, strategic thinking, and reflection. As noted by Rittle-Johnson et al. (2017), the process of explaining solutions or receiving peer explanations prompts deeper processing and comprehension of mathematical concepts. These interactions allow students to engage in higher-order thinking as they clarify doubts, reframe their understanding, and explore alternative methods of problem-solving. This type of engagement is crucial in mathematics, where conceptual understanding often requires sustained mental effort and active manipulation of information. Cross-age peer tutoring, therefore, serves not only as an instructional support but also as a catalyst for meaningful, sustained cognitive engagement.

Enhancing Student Engagement in Mathematics: An Instructional Guide Integrating Cross-Age Peer Tutoring and Traditional Lecture Methods

Student engagement in mathematics plays a critical role in shaping learning outcomes and fostering academic success. With increasing emphasis on interactive and student-centered learning, instructional strategies such as cross-age peer tutoring have emerged as effective approaches to promote participation, motivation, and deeper understanding. This guide presents a practical framework that integrates cross-age peer tutoring with traditional lecture methods, aiming to enrich student experiences and improve engagement in the classroom. The strategies outlined herein are based on research findings from the current study, offering teachers clear, actionable steps to support more dynamic and inclusive mathematics instruction.

Instructional Guide

Learning Together: Math Engagement Through Cross-Age Peer Tutoring and Guided Teaching
Mathematics remains a fundamental subject in the basic education curriculum, forming the foundation for logical reasoning, problem-solving, and critical thinking skills. However, many junior high school students encounter persistent difficulties in grasping mathematical concepts, which often leads to poor academic performance and diminished interest in the subject. To address these challenges, innovative and learner-centered strategies must be employed to support struggling students and sustain engagement in mathematics learning. One such strategy is cross-age peer tutoring, which harnesses the social and cognitive benefits of peer interaction to enhance learning.

Rationale

Cross-age peer tutoring is grounded in well-established educational theories such as Bandura's Social Learning Theory, Vygotsky's Sociocultural Theory, and Deci and Ryan's Self-Determination Theory. These frameworks emphasize modeling, scaffolding, and motivation as essential elements of effective learning. Through the guidance of trained Grade 9 student tutors, younger learners in Grade 7 can receive personalized instruction in a low-pressure, collaborative environment. The interaction allows for scaffolding within the learners' Zone of Proximal Development (ZPD), while promoting confidence, autonomy, and competence in mathematics. This guide provides a structured implementation plan to institutionalize cross-age peer tutoring within the school setting and align it with the Department of Education's Enhanced Results-Based Performance Management System competencies.

Objectives

The instructional guide aims to:
• Provide a structured and replicable framework for implementing a cross-age peer tutoring program in Grade 7 Mathematics.
• Clarify tutors' and tutees' roles and responsibilities to ensure meaningful engagement.
• Align weekly tutoring sessions with specific learning competencies in the Grade 7 Mathematics curriculum.
• Foster positive peer interactions that enhance academic performance, confidence, and interest in mathematics.
• Include tools for monitoring progress, assessing learning outcomes, and improving instructional delivery through feedback.

This instructional guide outlines the week-by-week structure for implementing cross-age peer tutoring in Grade 7 Mathematics. Each session promotes numeracy, engagement, and scaffolded support from Grade 9 tutors. It includes the roles of participants, session format, targeted competencies, and feedback tools.

Week	Focus Competency (ERUNT-Aligned)	Session Structure	Roles of Tutors & Feedback
Week 1	Whole Numbers and Operations	Orientation, Diagnostic Quiz, Ice Breaker Math Activities	Tutors assist in diagnostics, build rapport, and observe tutee behavior
Week 2	Fractions and Decimals	Concept review, peer explanation, practice problems	Tutors guide problem-solving, provide corrective feedback
Week 3	Integers and Operations	Mini-lesson, pair activity, quiz	Tutors scaffold tasks, monitor engagement, and log challenges
Week 4	Integers and Applications	Discussion with visuals, real-life problems, and seatwork	Tutors give examples, assist in contextual understanding

Cross-age peer tutoring feedback form

This feedback form is designed to collect insights from both tutors and tutees regarding their experiences during the cross-age peer tutoring sessions in mathematics. The responses will help evaluate the effectiveness of the sessions and identify areas for improvement.

Tutee Feedback Form

Directions: Please rate your level of interest in mathematics by putting a check (/) mark next to the most appropriate response for each statement.

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Statements	Highly Agree (4)	Agree (3)	Slightly agree (2)	Disagree (1)
The tutor explained the math concepts clearly.				
I felt comfortable asking questions during the session.				
The tutoring session helped me understand the topic better.				
The session was engaging and interactive.				
I am more confident in solving math problems after the session.				
The tutor treated me with respect and encouraged me to participate.				

Statements	4	3	2	1
I was able to explain the math concepts effectively.				
I was engaged and participated actively.				
Teaching strategies are appropriate to the tutee's level of understanding.				
I received support and guidance in answering the math problems.				
I found the tutoring session to be a valuable teaching experience.				
The feedback provided by the tutor was constructive and helpful.				

Legend. 1.00-1.49=Disagree; 1.50-2.49=Slightly agree; 2.50-3.49=Agree; 3.50 4.00=Highly Agree

CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusion and recommendations based on the results and analysis of the data gathered in the preceding chapters. It revisits the main objectives of the study, synthesizes the key outcomes, and draws evidence-based conclusions. Furthermore, it outlines practical recommendations for educators, administrators, and future researchers, grounded in the findings of the research. This chapter aims to provide a comprehensive closure to the study and offer direction for further action or investigation.

Conclusion

The findings of this study demonstrate that cross-age peer tutoring significantly enhances student engagement and numeracy skills in mathematics compared to the traditional lecture method. Students who participated in peer tutoring showed notable improvement in classroom participation and numeracy proficiency. Peer tutoring not only enhances academic outcomes but also fosters a collaborative learning environment, promoting active participation and mutual support among students. These results suggest that integrating peer tutoring into secondary education curricula can be an effective strategy for improving student learning and engagement (Abdullah & Usman, 2020).

Although the lecture method also contributed to engagement, its impact was comparatively less substantial. These results highlight the value of student-centered and interactive teaching strategies, which foster deeper learning experiences through collaboration, active involvement, and shared responsibility. The positive outcomes associated with cross-age peer tutoring align with existing educational literature, reinforcing its relevance and potential for integration into mathematics instruction.

Recommendations

In light of the findings, it is recommended that cross-age peer tutoring be integrated into the mathematics curriculum as a key instructional strategy to improve student engagement. This approach has demonstrated its potential in fostering active participation, collaboration, and deeper interest in learning. To ensure its successful implementation, schools should provide training and structured guidance for peer tutors, equipping them with the necessary skills and responsibilities to facilitate meaningful learning experiences.

Additionally, teachers are encouraged to adopt a blended approach that combines peer tutoring with traditional lectures to accommodate various learning styles and reinforce content mastery. Creating a classroom environment that promotes cooperative learning, peer interaction, and student-led discussions can further enhance engagement and comprehension. Lastly, it is suggested that future research be conducted to assess the long- term impact of peer tutoring across different subjects and grade levels, as well as its influence on academic performance, self-efficacy, and social development.

Based on the findings and insights from this study, it is recommended that schools and educators adopt and integrate the instructional guide Learning Together: Math Engagement Through Cross-Age Peer Tutoring and Guided Teaching into their regular mathematics teaching practices. This guide has demonstrated potential to enhance student engagement, improve mathematical understanding, and foster a collaborative learning environment.

Limitations

Despite the promising potential of cross-age peer tutoring in enhancing numeracy and student engagement, this study is not without limitations. One significant limitation is the limited generalizability of the findings due to the small sample size and the focus on a single educational setting. According to Creswell (2014), small-scale interventions often produce context-bound results, making it difficult to extrapolate outcomes to a broader population. Furthermore, the variability in the peer tutors' skill levels and teaching effectiveness may affect the consistency of the tutoring outcomes. Vygotsky's (1978) Zone of Proximal Development (ZPD) theory underscores the importance of guided interaction with a more capable peer; however, if the tutor lacks sufficient mastery or communication skills, the learning may be compromised. Additionally, the short duration of the intervention may not allow for meaningful measurement of long-term gains in both numeracy and interest. Interest development, as described by Hidi and Renniger (2006), is a gradual process that evolves, requiring sustained engagement and support. Lastly, the study's reliance on self-reports to measure interest introduces the risk of social desirability bias, potentially distorting the results (Fraenkel, Wallen, and Hyun, 2012). These limitations suggest that future research should involve a larger and more diverse sample, extended intervention periods, and multiple data sources to validate findings.

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